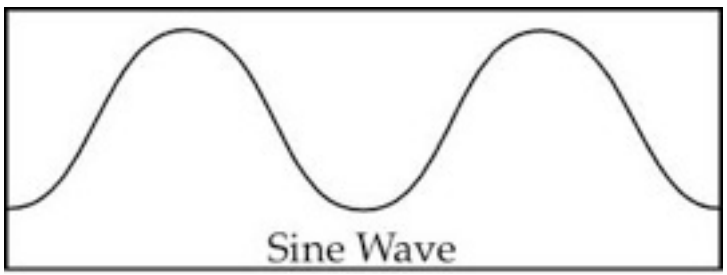
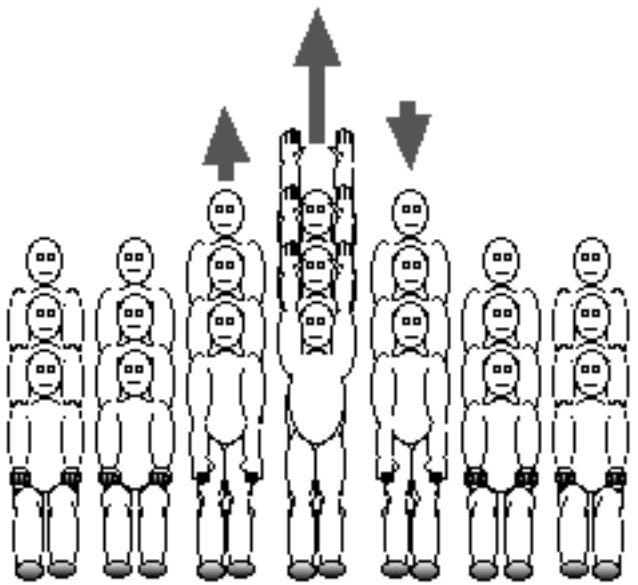
WAVES

WAVES

Physical Science

Waves are everywhere in nature





Waves are everywhere in nature

- Sound waves
- visible light waves
- radio waves
- microwaves
- water waves
- sine & cosine waves

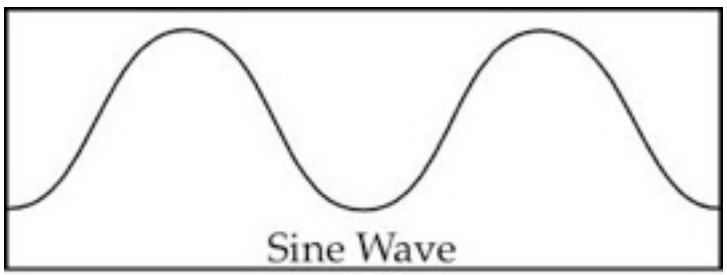
-telephone waves

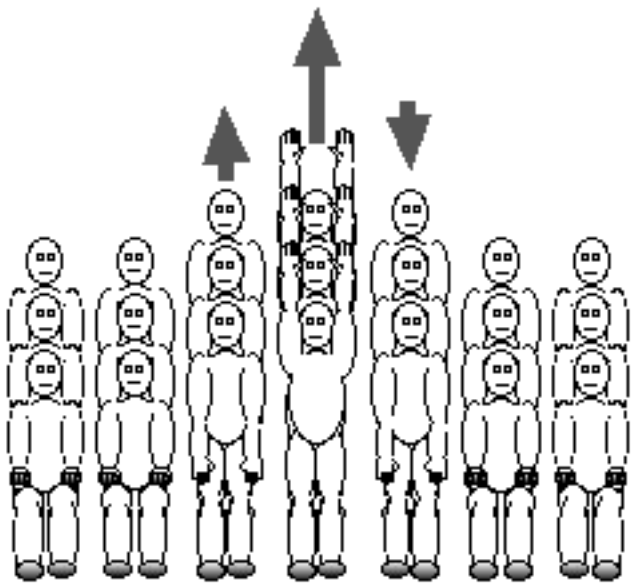
-earthquake waves

-waves on a string

-slinky waves

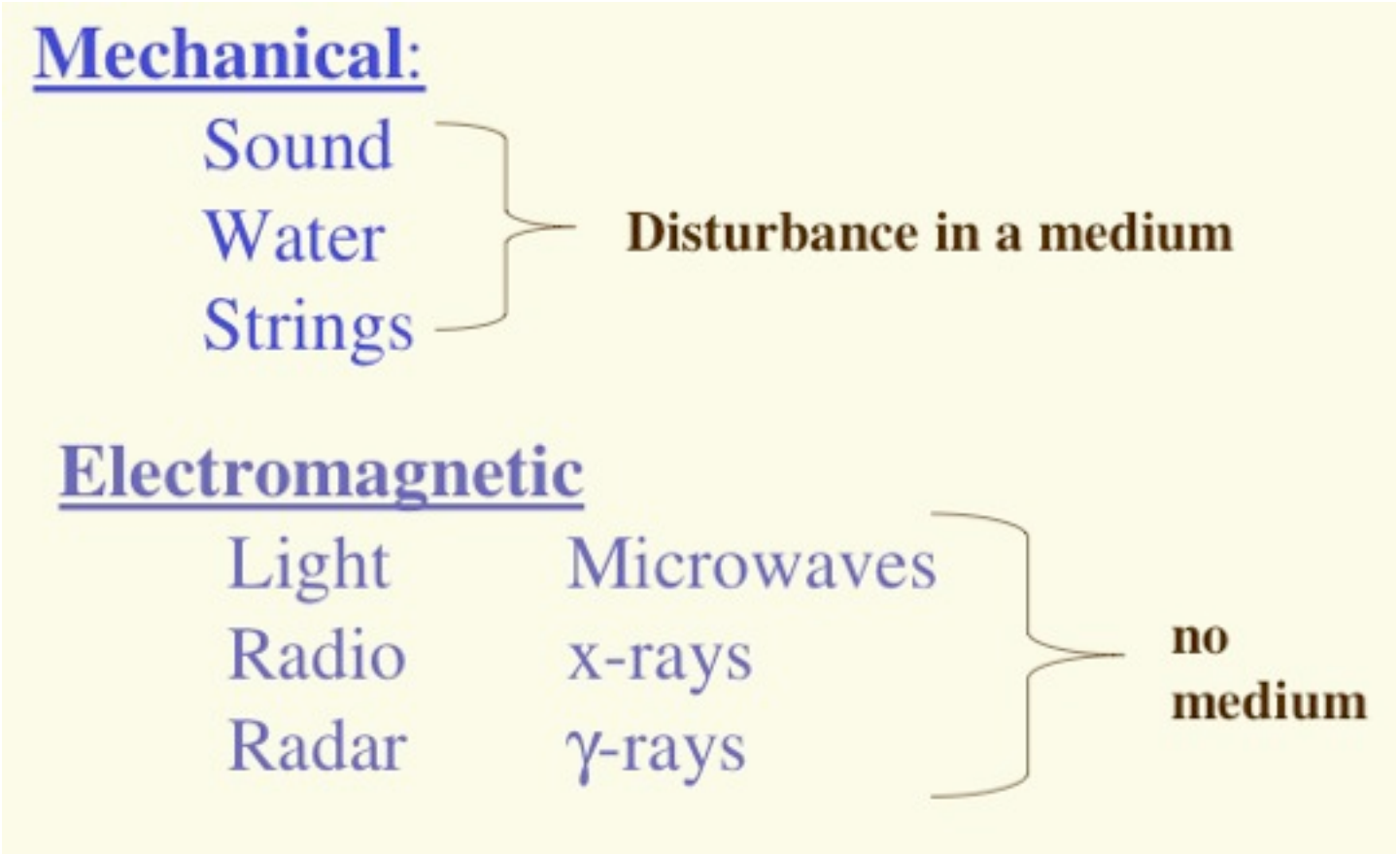
-stadium waves





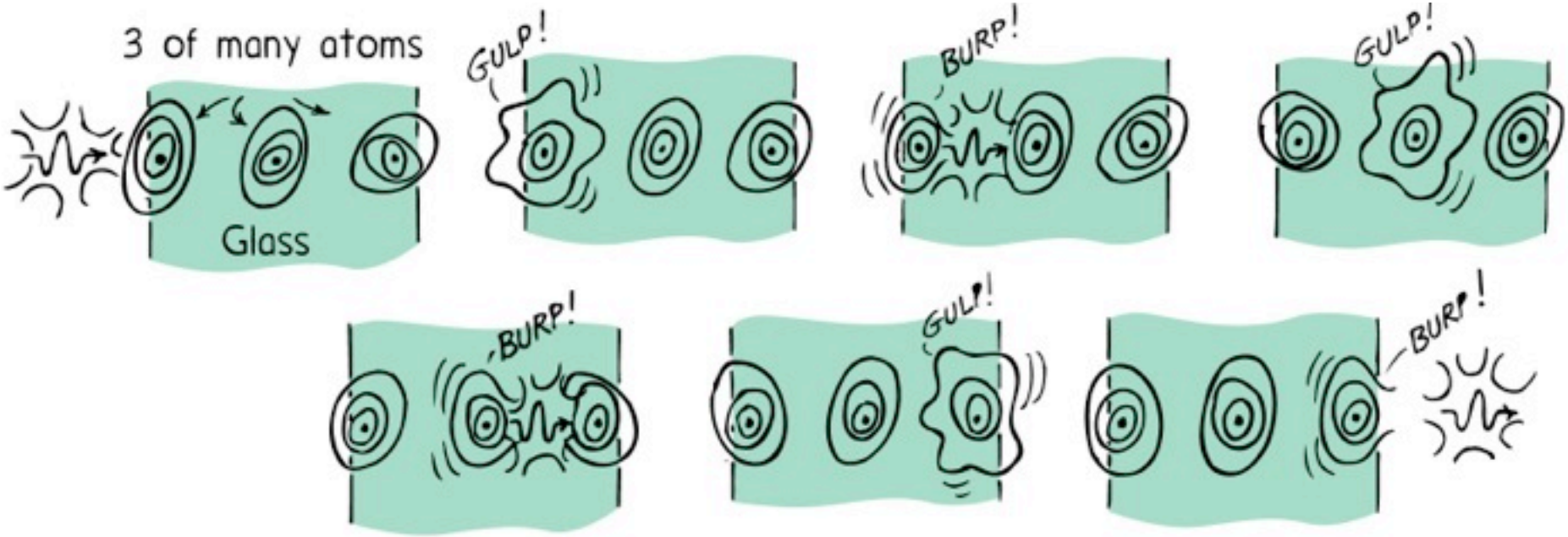
Waves

I. Wave: disturbance that transfers _____ progressively from point to point - some waves require a medium, some do not



Waves

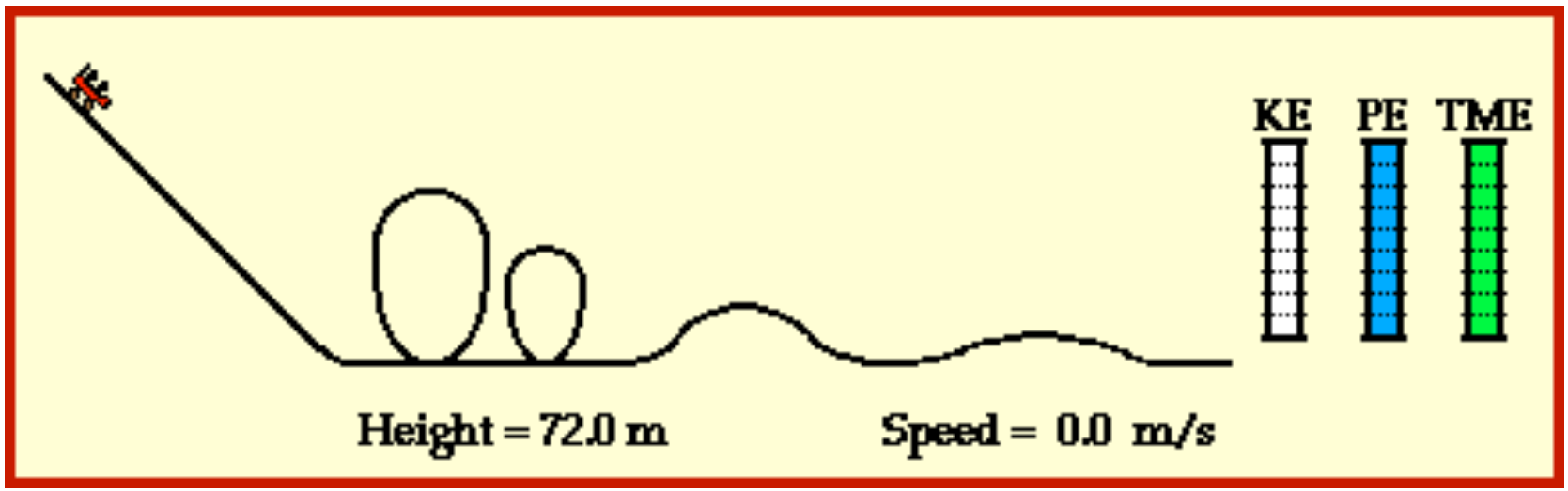
A._____: anything that waves pass through that is not just empty space



Types of energy:

- Kinetic and potential
- Thermal energy (endothermic and exothermic)
-Sound
-Light

KE versus PE



Thermal Energy (heat energy)

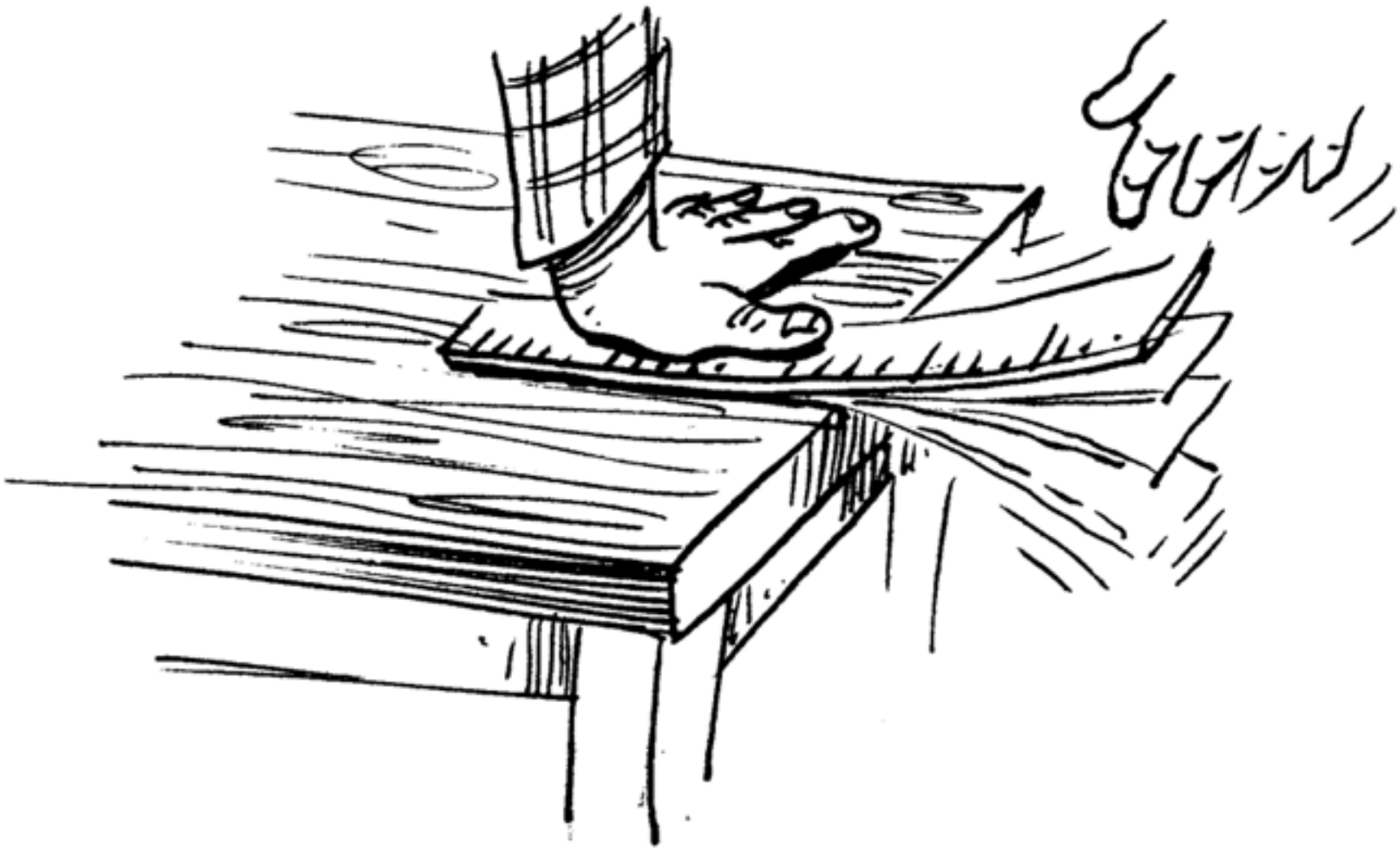
_____ - To absorb heat (Heat moves from the surroundings to the system)

Example: Holding an ice cube

_____- To radiate or give off heat (Heat moves from system to the surroundings)

Example: A firework

Sound (vibrations)

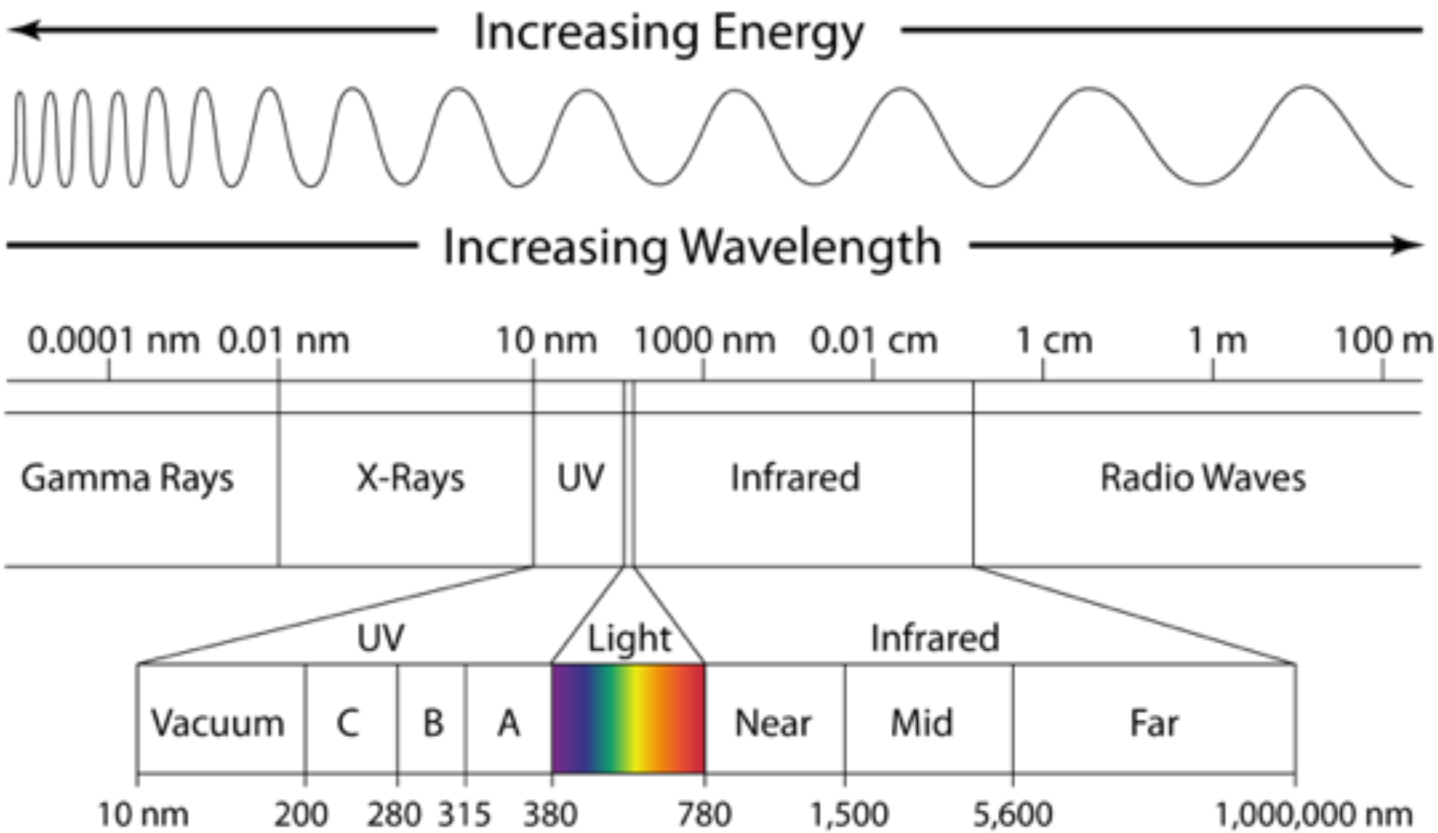


Sound (vibrations)

http://www.youtube.com/watch?v=1yaqUI4b974

As the sound **frequencies** from the speaker make the plate vibrate, the sand gravitates to those areas where there are less vibrations, and creates sand patterns

Light (the electromagnetic spectrum) - we will talk about this later



WAVES

BACK TO

WAVES

BACK TO

WAVES

Waves

A.Types of Waves

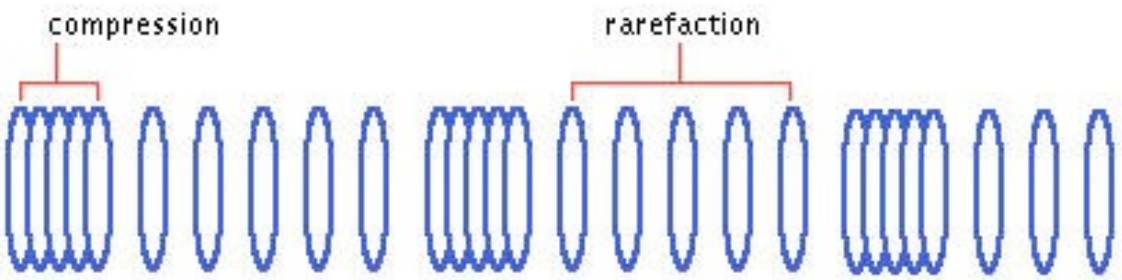


Figure 1: Longitudinal Wave

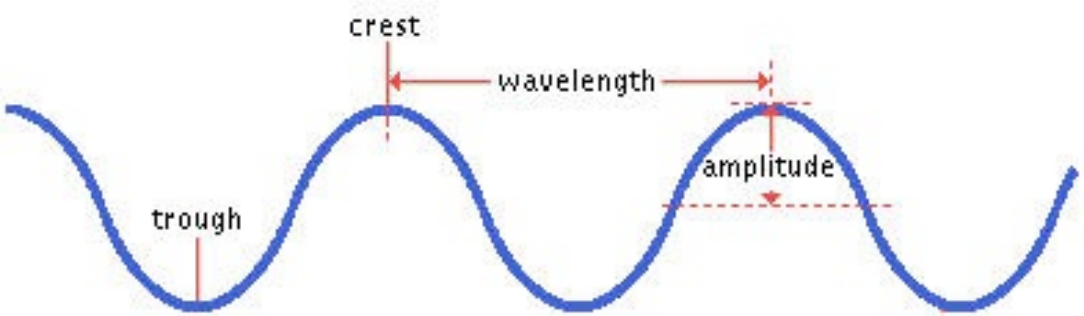


Figure 2: Transverse Wave

Longitudinal wave

Source moves left and right

Coils move left and right

Energy Transport

Transverse Wave

Source moves up and down

Coils move up and down

Energy Transport

The subsequent direction of motion of individual particles of a medium is the same as the direction of vibration of the source of the disturbance.

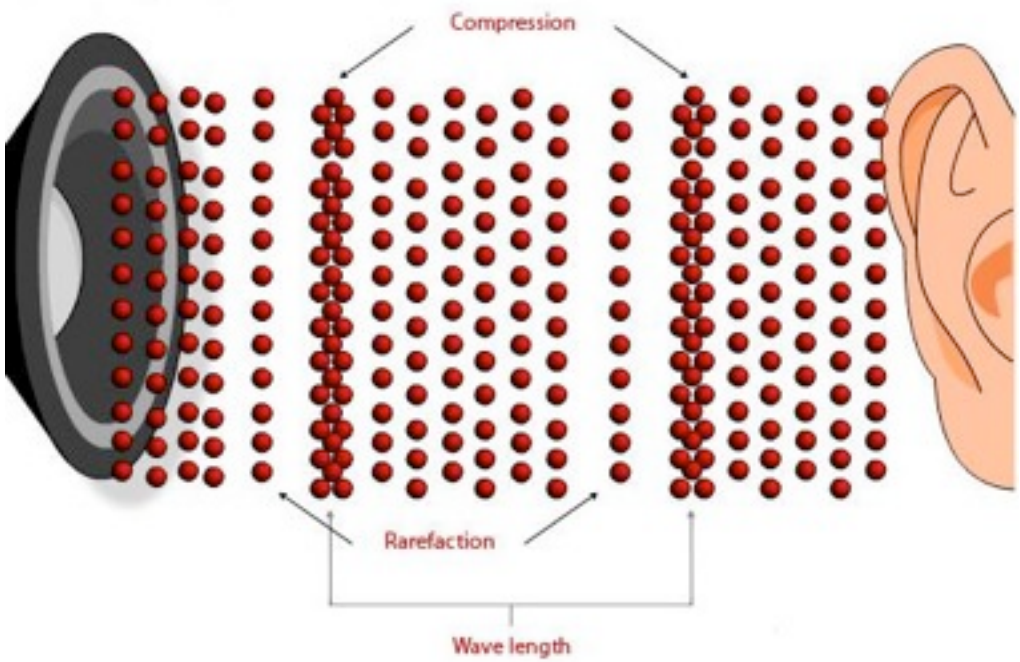
Slinky Wave

- Energy is being _____
- The metal of the slinky is the _____ that the wave pulse is transferred through
- The medium ends up in the same place that it started in
- The same can be seen with a stadium wave

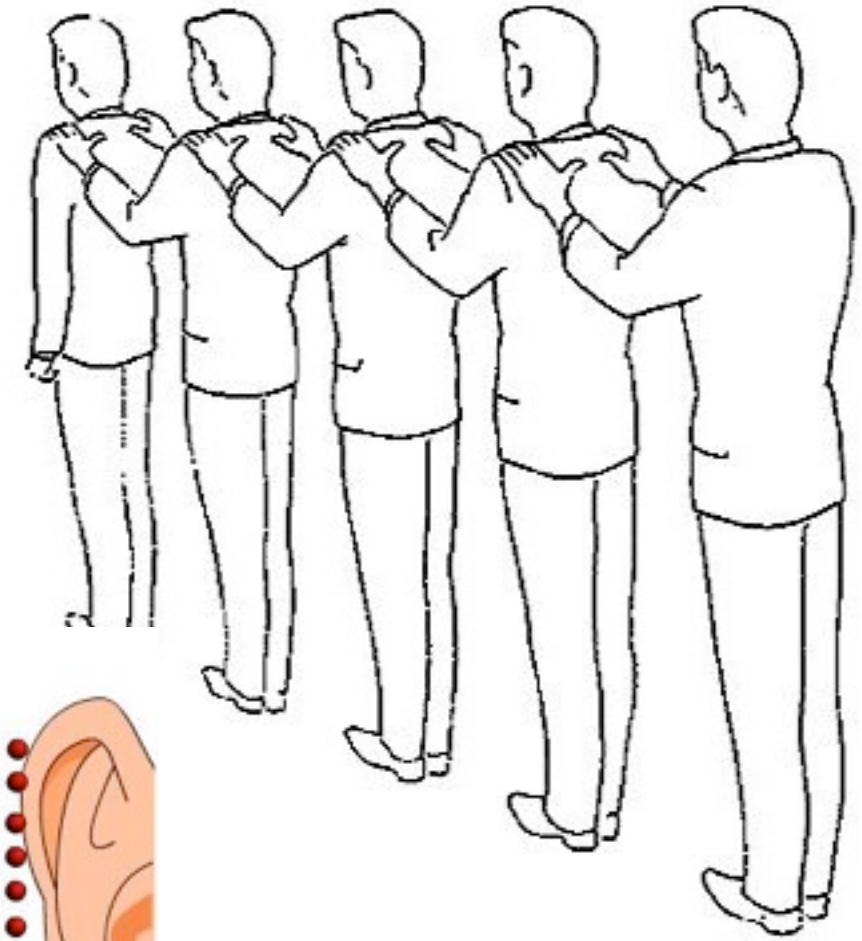
Longitudinal Wave

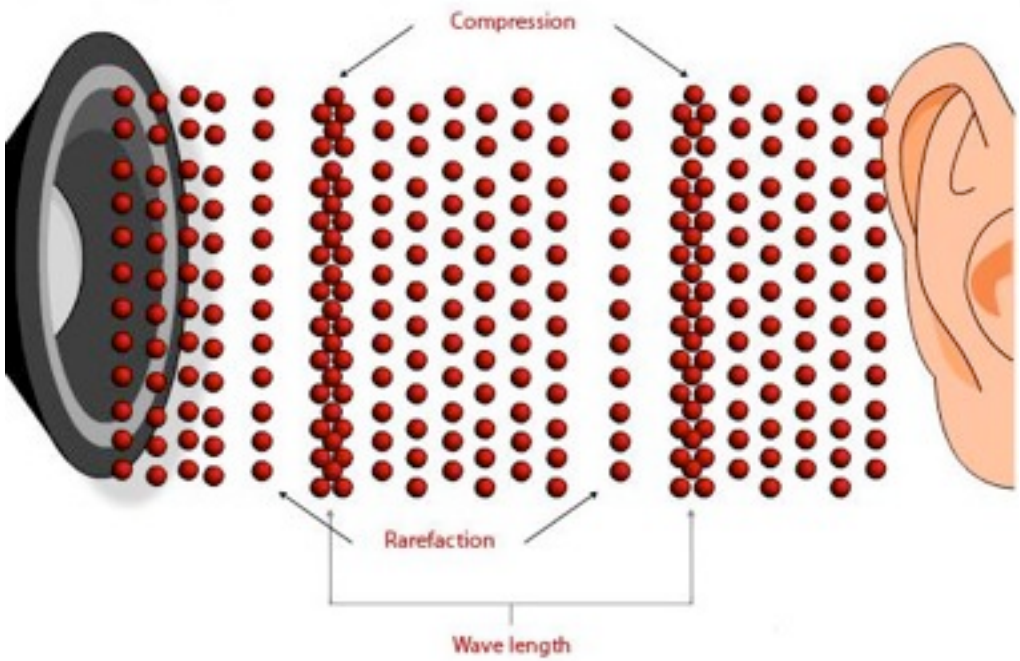
- The medium particles vibrate _____ to to motion of the pulse
- This is the same type of wave used to transfer sound

Longitudinal Waves



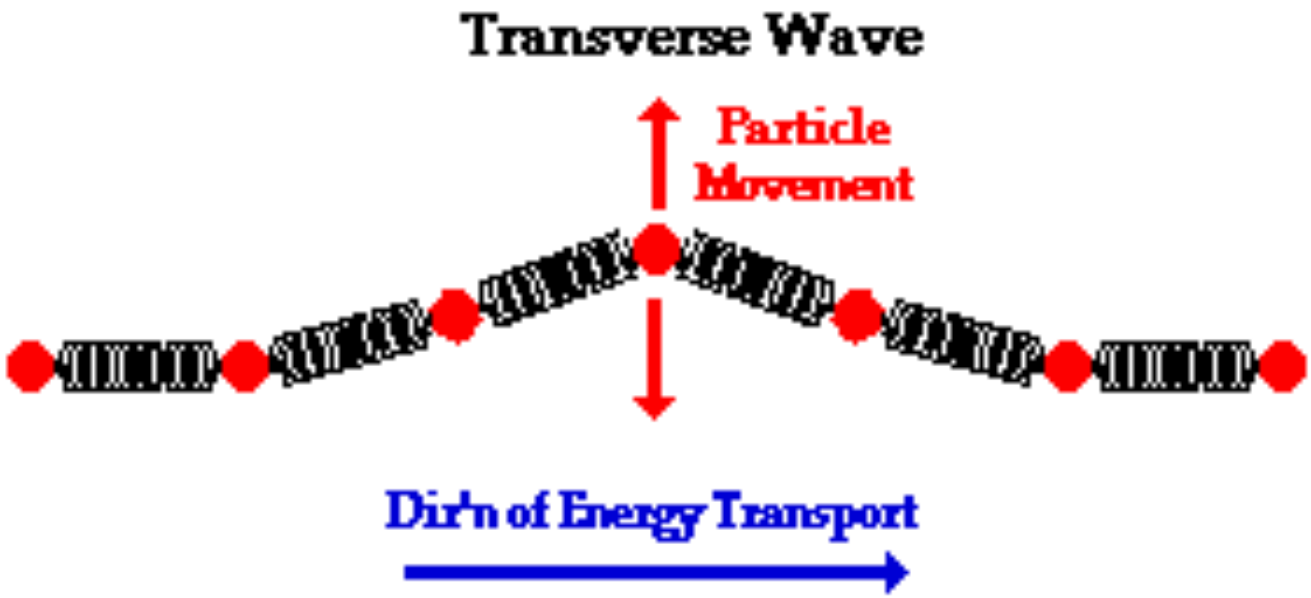
Longitudinal Waves





Transverse Wave

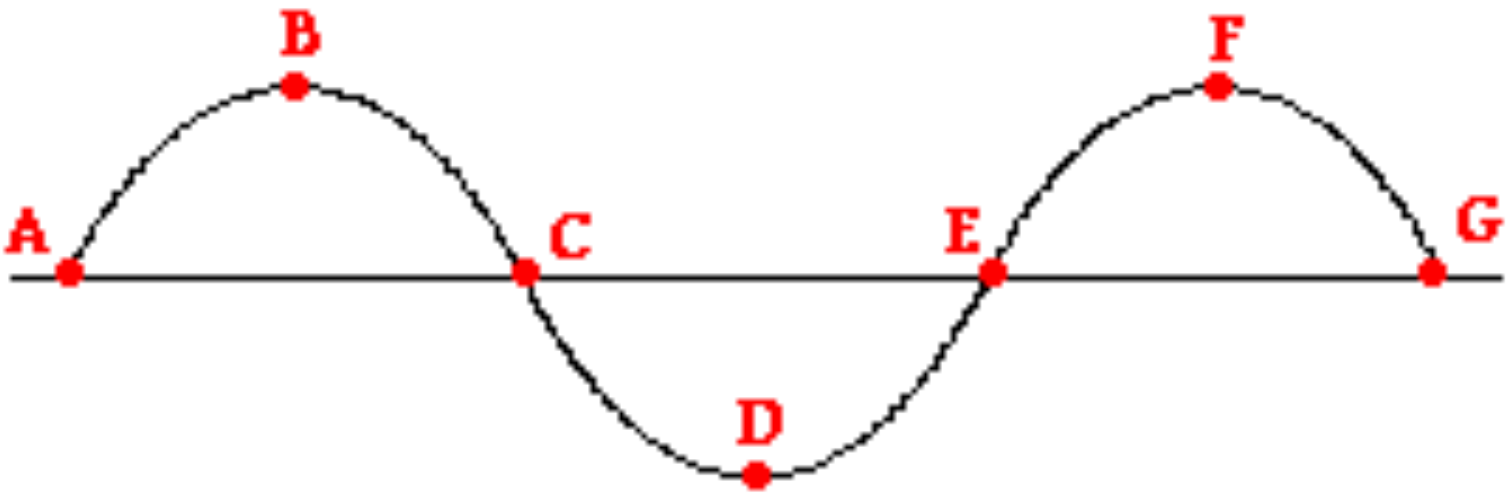
- In a transverse wave, the pulse moves _____ to the disturbance



Anatomy of a wave

The middle line represents the _____ _____

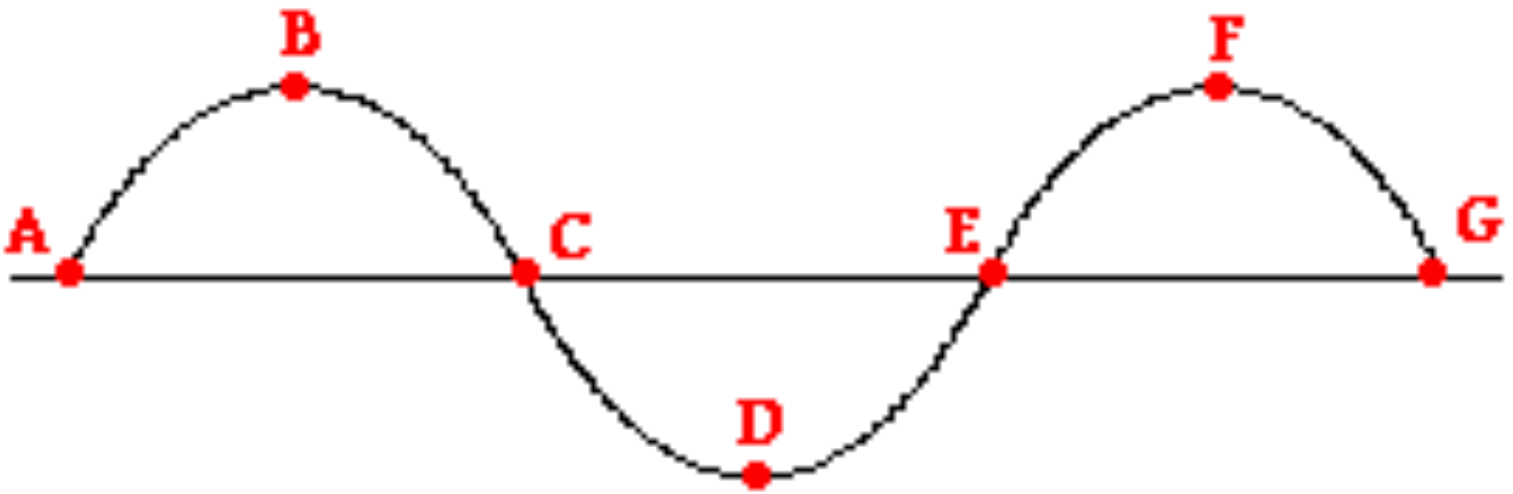
Once the medium is disturbed it moves away from this position and then eventually returns to it



Anatomy of a wave

Points B and F are called the _____ of the wave.

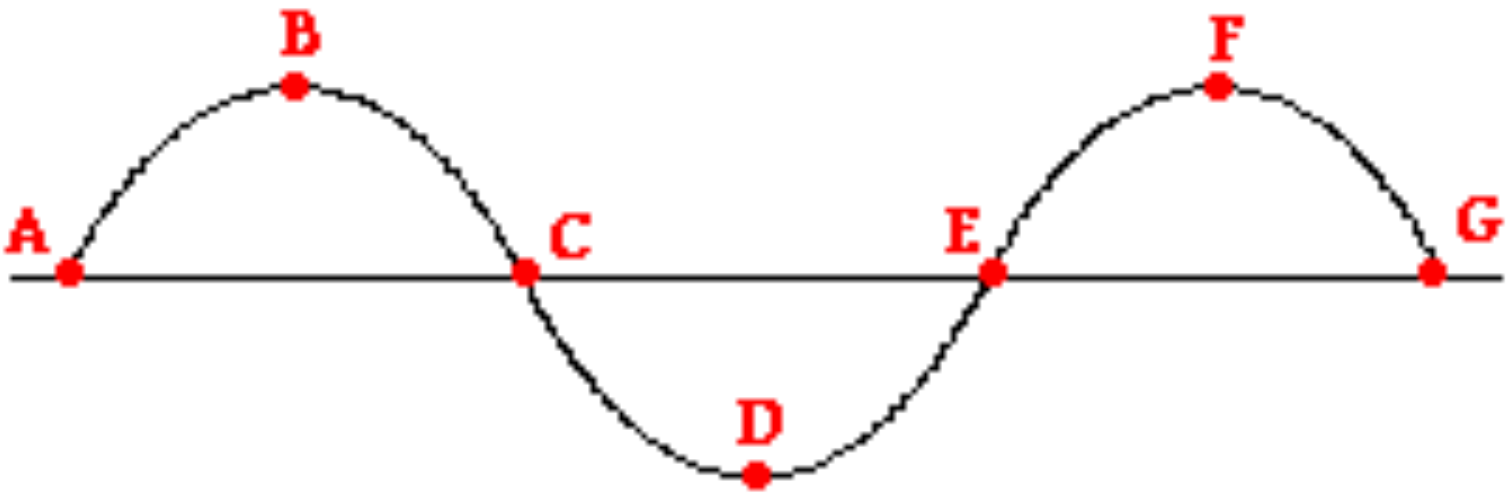
They are the HIGHEST points



Anatomy of a wave

Point D is called the _____ of the wave.

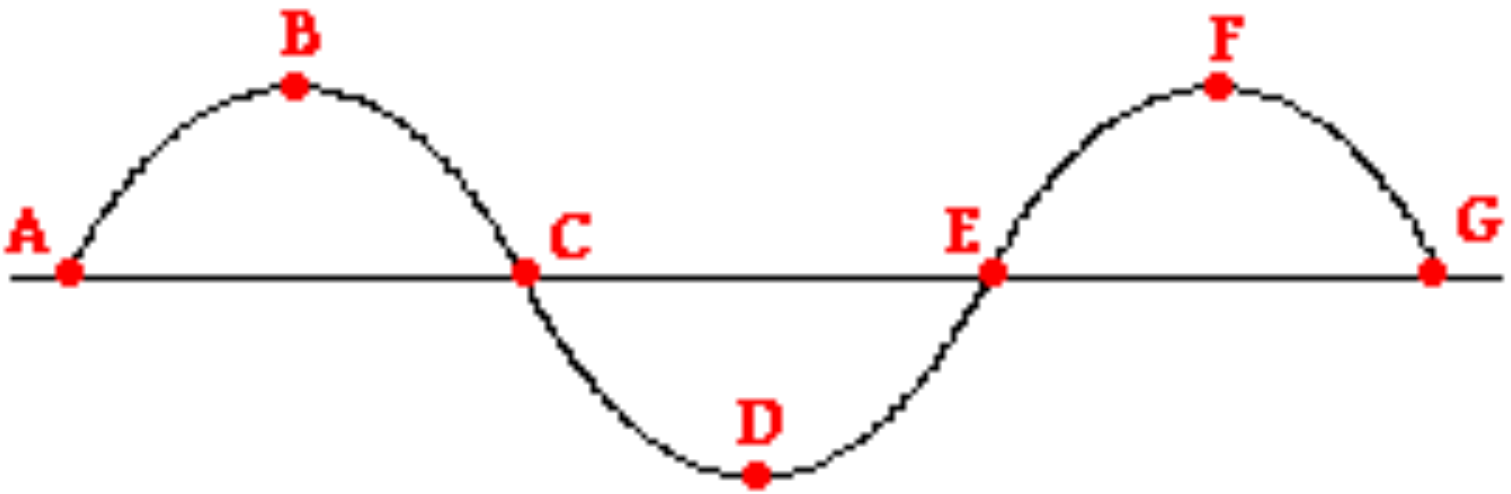
It is the LOWEST point



Anatomy of a wave

The distance between two consecutive similar points (in this case the two crests) is called the _____

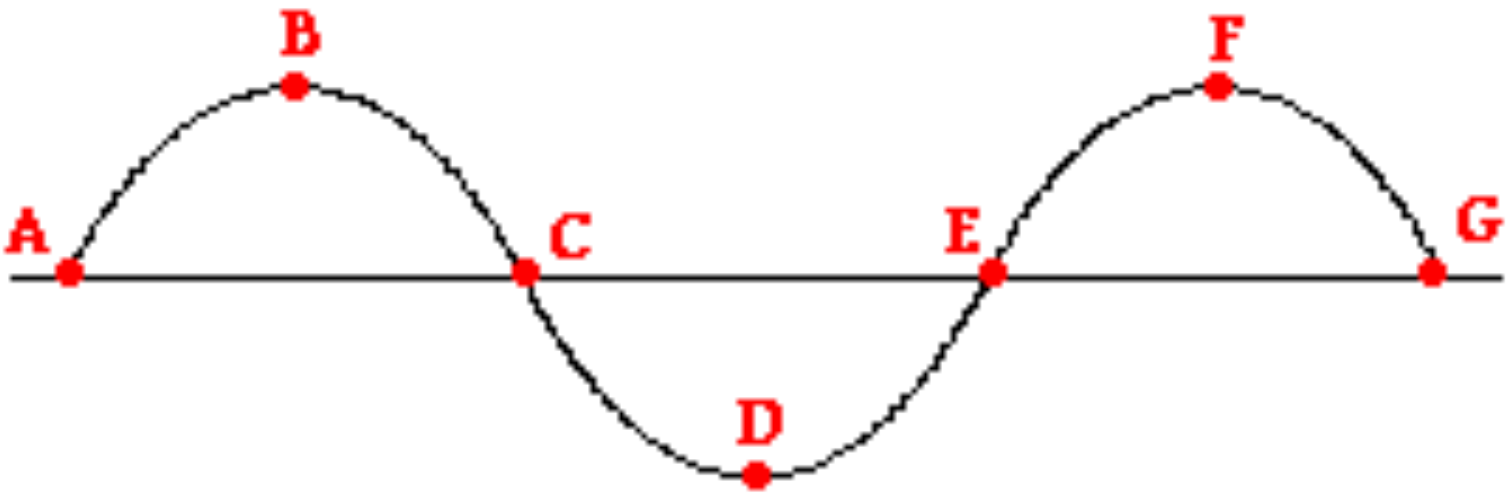
This is the length of the wave pulse



Anatomy of a wave

The distance between the equilibrium line and the crest or trough is called the _____

this is the maximum height and depth



WAVE FREQUENCY

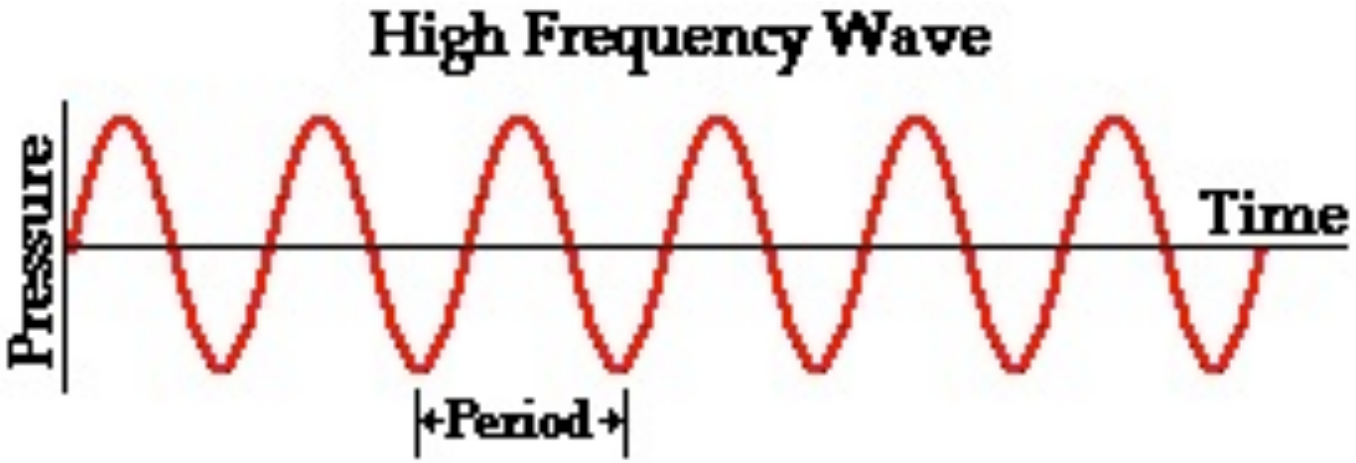
- We know that frequency measures how often something happens over a certain amount of time.... think of any survey that you have taken.... You go to a sporting event __ times per week, You have ___ hours of schools work a night, You attend a social even ___ times per month ETC... these are example of frequency
- We can measure the frequency of a wave by measuring the amount of times a pulse passes through a fixed point over a given period of time and this will give us the frequency

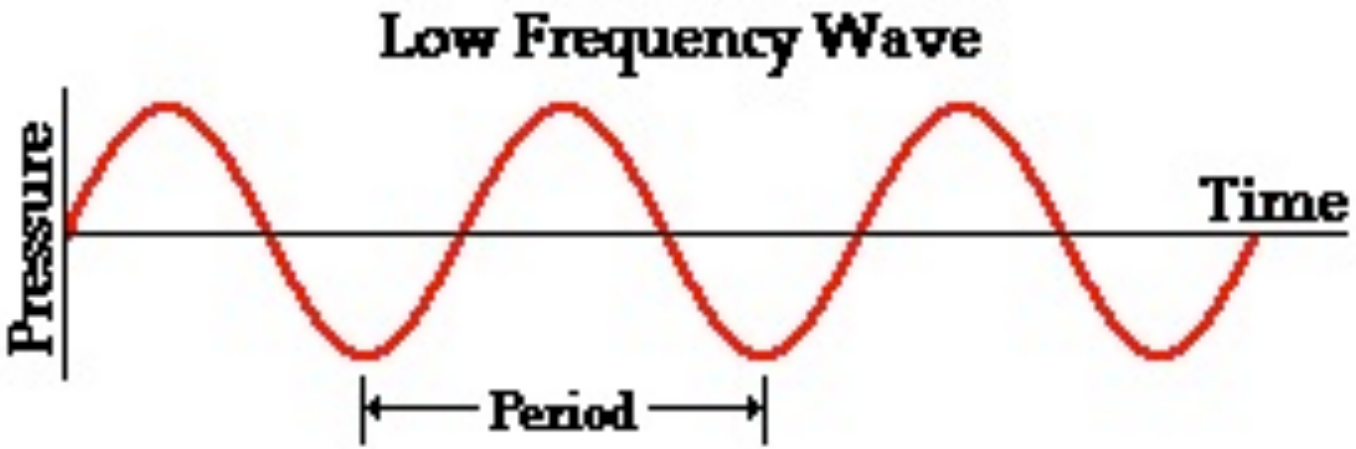
WAVE FREQUENCY

- Suppose I wiggle a slinky back and forth and count that 6 waves pass in 2 seconds, would would the frequency be?

- 6 waves / 2 seconds
- = 3 waves / second
- = 3 hertz (Hz)
- Hertz stands for wave cycles per second

Frequency


High Frequency Wave
Pressure
Time
Period


Low Frequency Wave
Pressure
Time
Period

Wave period / Wave cycle

- The period (T) of a wave is the time for a particle on a medium to make one complete vibrational cycle (wave)
- It is the reciprocal of the frequency
- $T = 1/f$
- $f = 1/T$

Wave Speed

- We can use what we know to determine how fast the wave is moving
- What is the formula for velocity?
- ------ velocity = displacement / time
- What distance do we know about a wave
- ------ wavelength
- and what time do we know?
- ----- period

Wave Speed

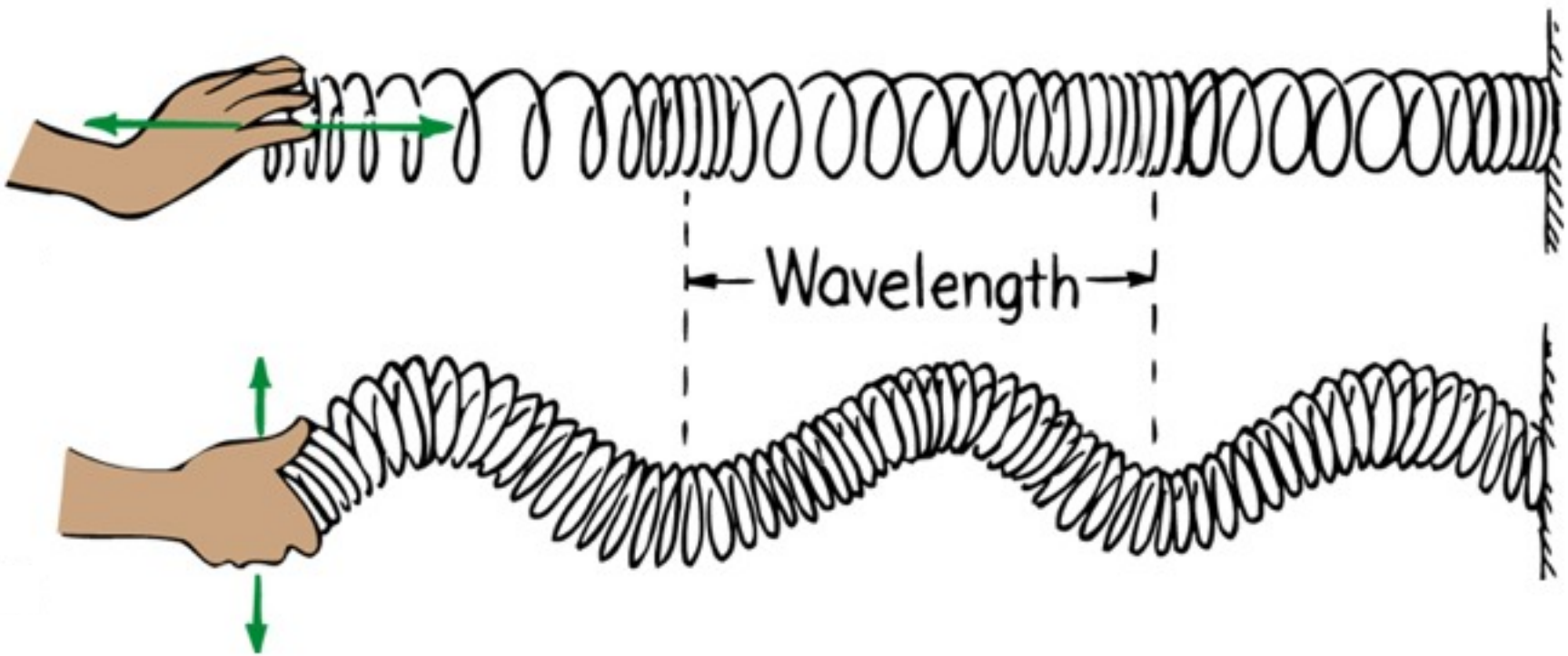
- if we plug these in we get
- velocity = length of pulse (wavelength) / time for pulse to move past a fixed point (period)
- $v = \lambda/T$
- We use λ (LAMDA) to represent wavelength

Wave Speed

- $v = \lambda / T$
- but what does T =
- $t = 1/f$
- So we can also write this as
- $v=f \lambda$
- velocity = _____ x _____
- This is THE WAVE EQUATION

Waves

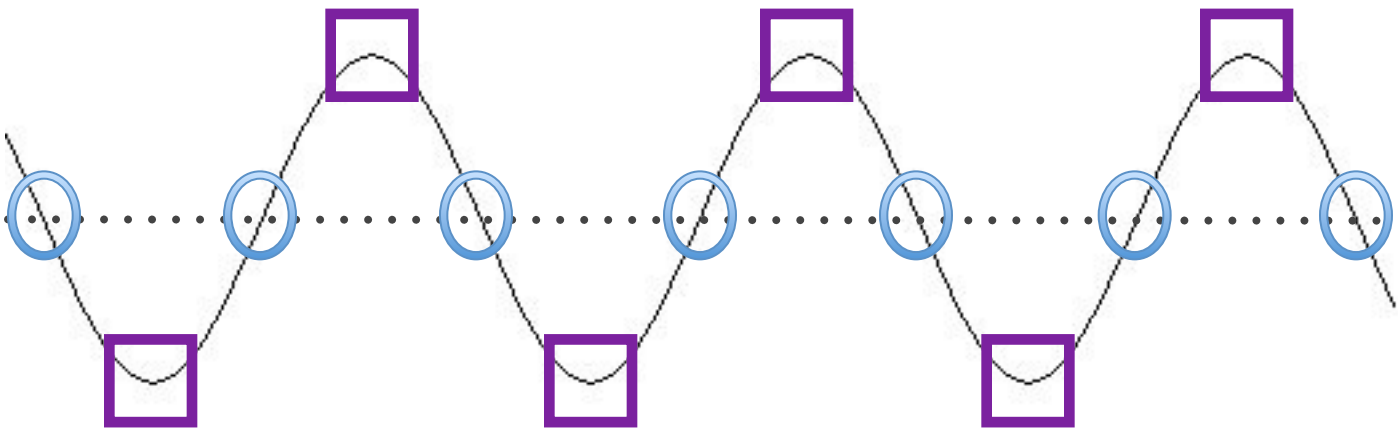
a. Compression: high pressure point of wave
b. Rarefaction: low pressure point of wave



Waves

III. Standing waves

A. _____: points of low energy (circles)

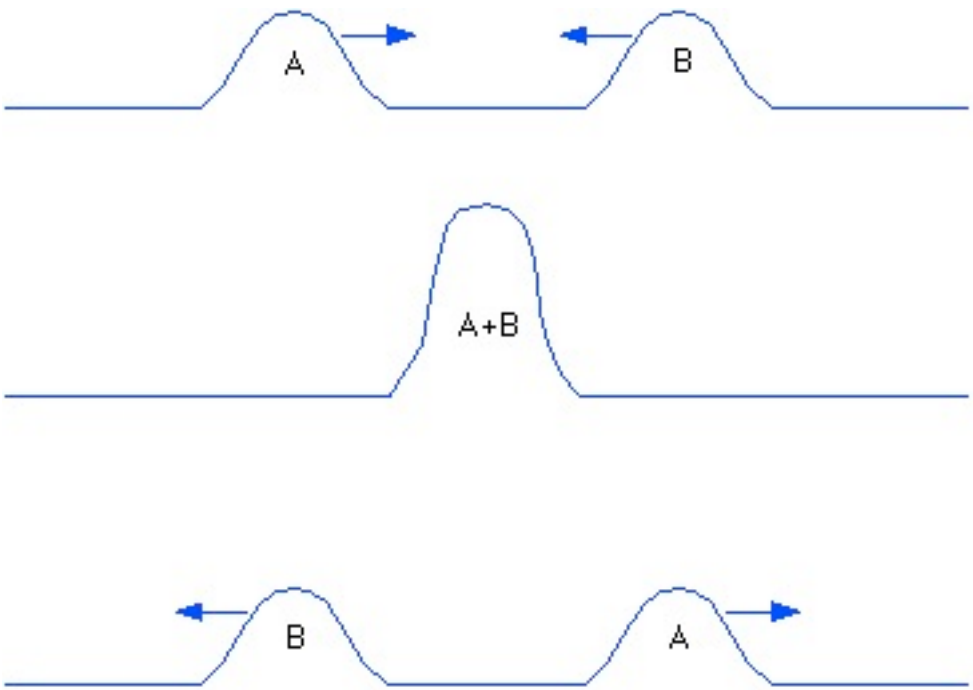


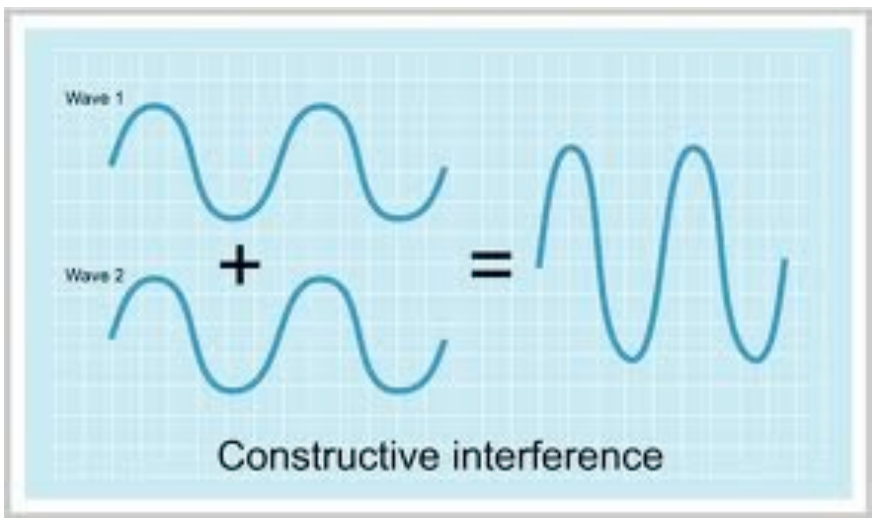
B. _____: points of high energy (squares)

Waves

IV. Wave Interference

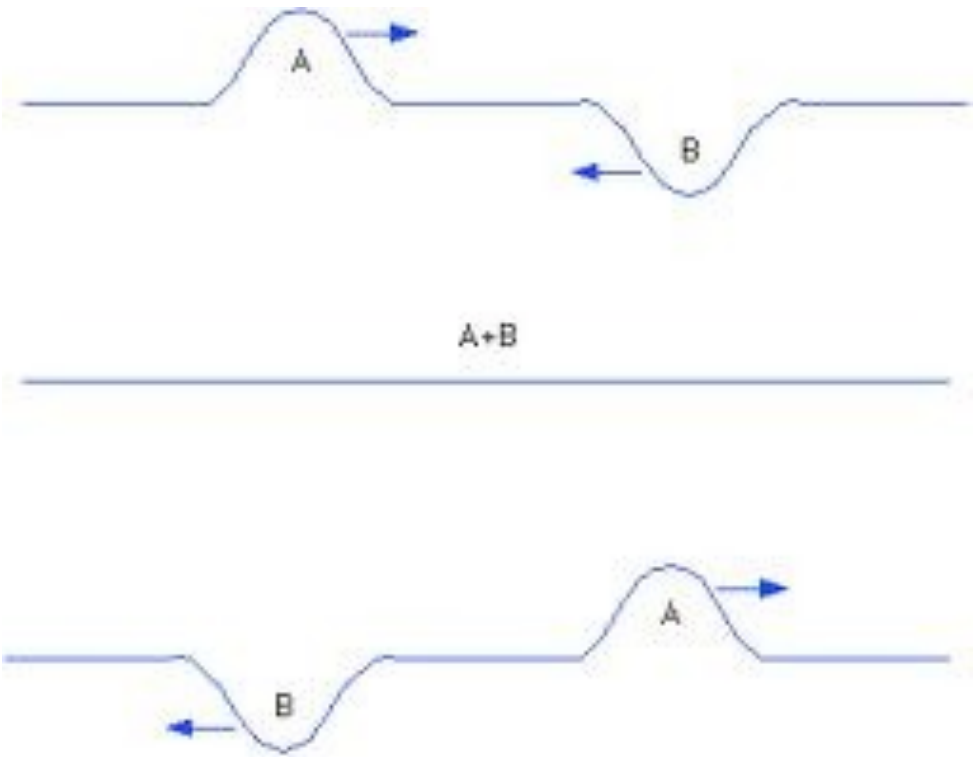
A. _____: amplitude of wave increases

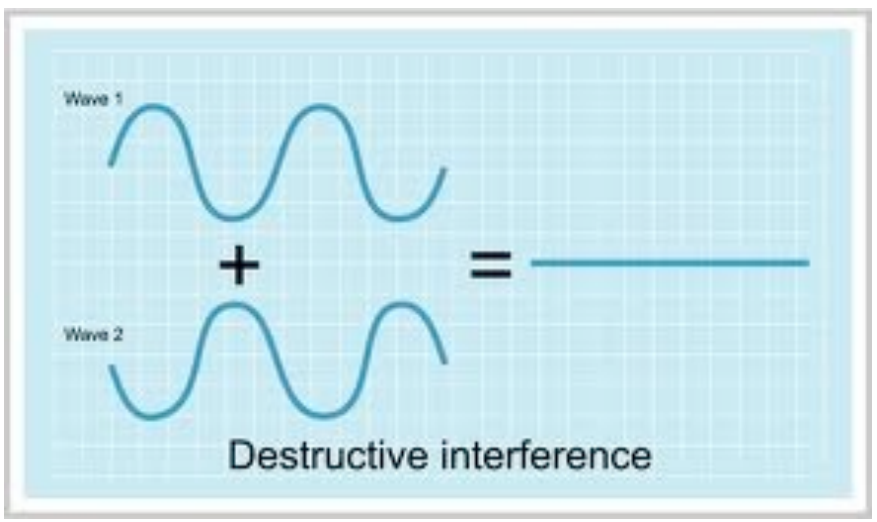




Waves

B._____: amplitude of wave decreases





Wave frequency

- Suppose I wiggle a slinky back and forth, and count that 6 waves pass a point in 2 seconds. What would the frequency be?

Wave frequency

- Suppose I wiggle a slinky back and forth, and count that 6 waves pass a point in 2 seconds. What would the frequency be?
  - 3 cycles / second

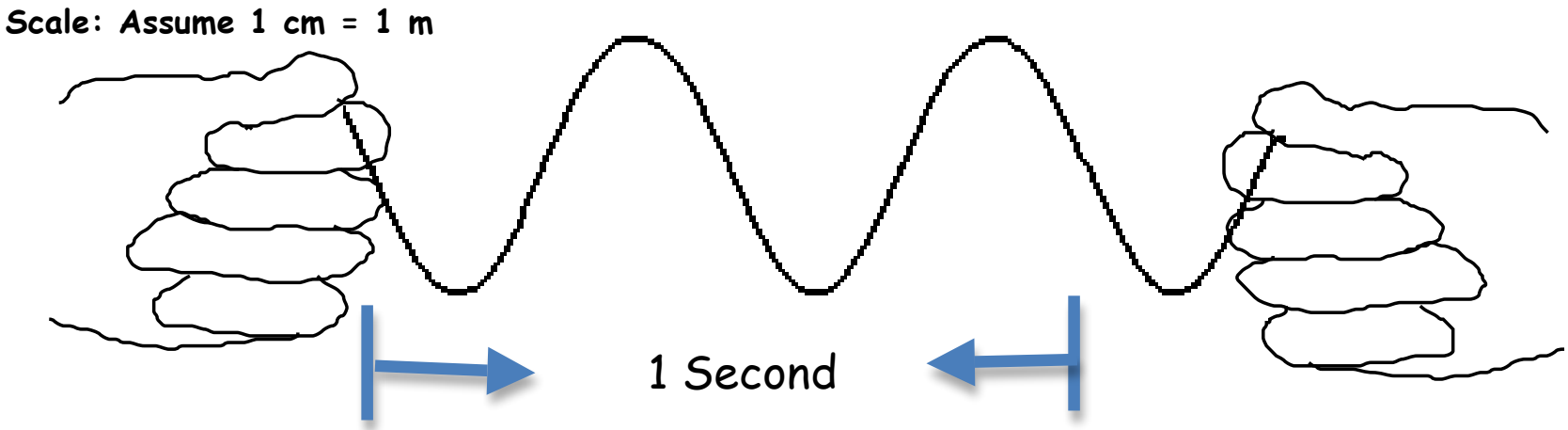
Wave frequency

- Suppose I wiggle a slinky back and forth, and count that 6 waves pass a point in 2 seconds. What would the frequency be?
  - 3 cycles / second
  - 3 Hz

Wave frequency

- Suppose I wiggle a slinky back and forth, and count that 6 waves pass a point in 2 seconds. What would the frequency be?
  - 3 cycles / second
  - 3 Hz
  - we use the term Hertz (Hz) to stand for cycles per second.

Waves WS #2



. The sketch above illustrates a snapshot in time of a wave sent along a cord. The wave illustrated was generated by the hand on the left and has just reached the hand on the right.

a. Measure directly on the diagram to determine:

wavelength _____m amplitude _____m period _____s frequency _____Hz (cycles/sec) speed _____m/s

b. Directly on the sketch above label one wavelength, one crest, one trough, and one amplitude.

Wave Speed/Velocity

- Suppose I wiggle a slinky back and forth, and measure the wavelength as 3.8m and count that wave is traveling at a frequency of 2 Hz. What would the velocity of the wave be?

Wave Speed/Velocity

- Suppose I wiggle a slinky back and forth, and measure the wavelength as 3.8m and count that wave is traveling at a frequency of 2 Hz. What would the velocity of the wave be?
  - $v = f \lambda$

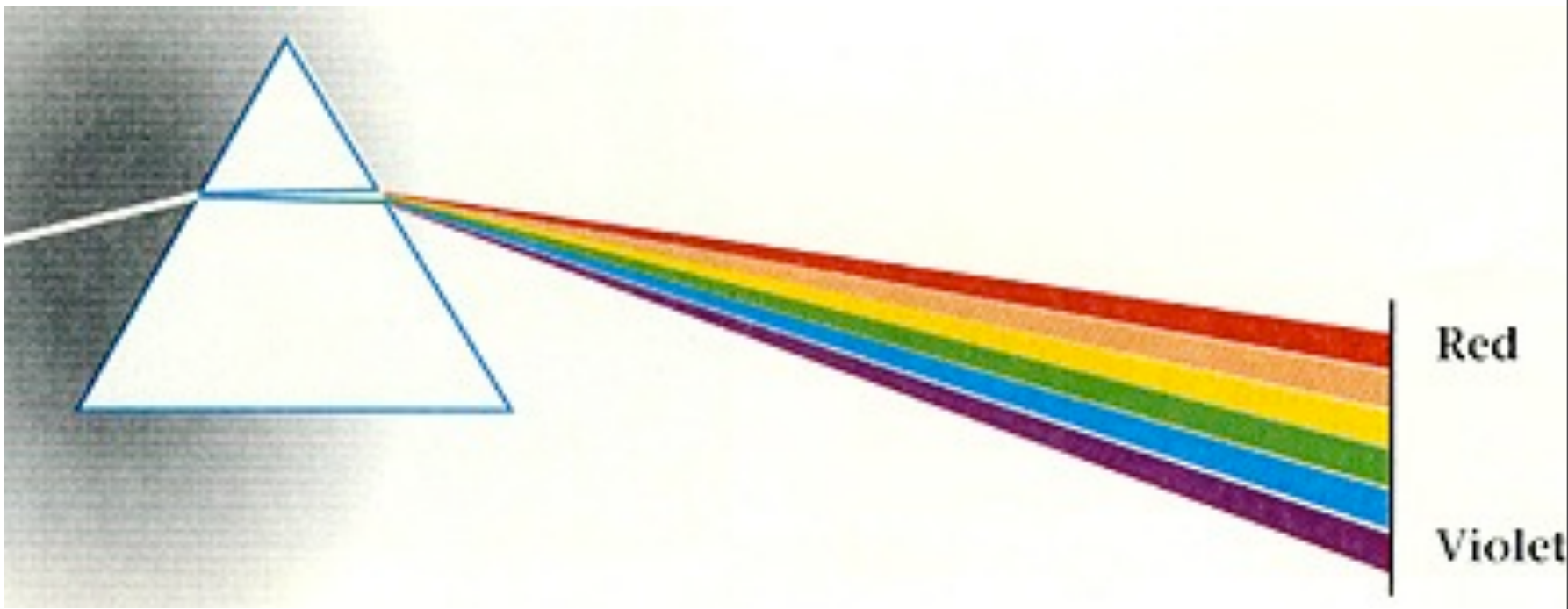
Wave Speed/Velocity

- Suppose I wiggle a slinky back and forth, and measure the wavelength as 3.8m and count that wave is traveling at a frequency of 2 Hz. What would the velocity of the wave be?
  - $v = f \lambda$
  - f = 2 Hz
  - λ = 3.8 m

Wave Speed/Velocity

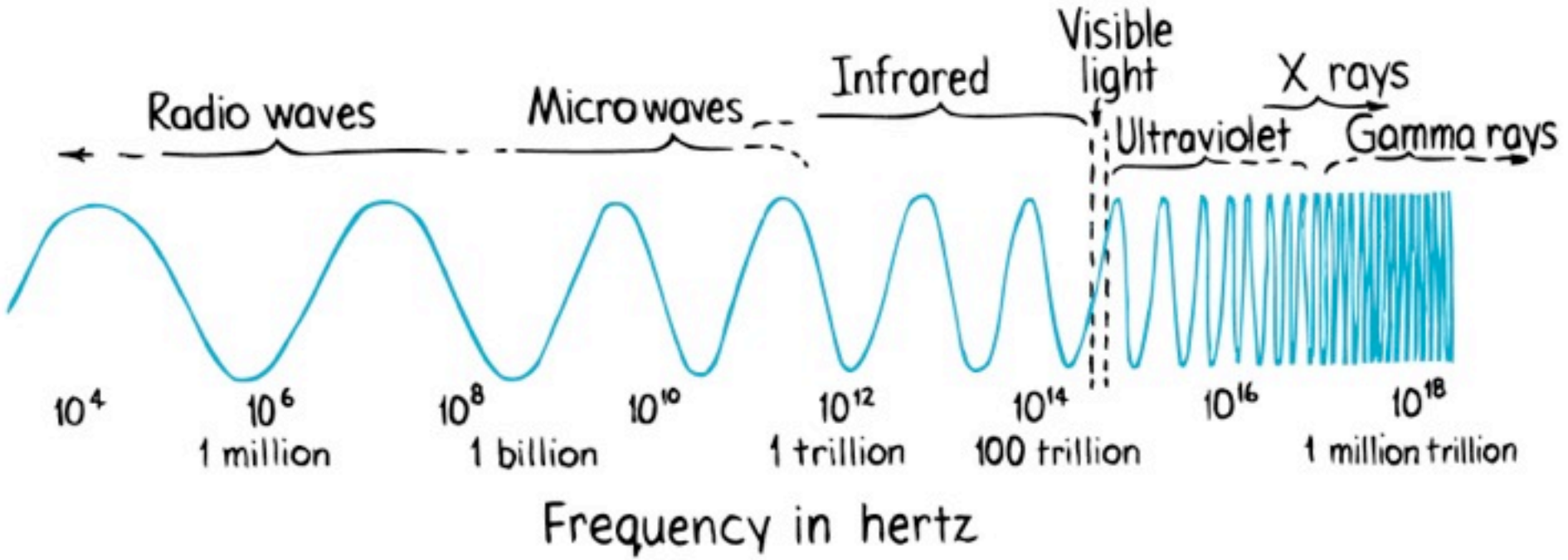
- Suppose I wiggle a slinky back and forth, and measure the wavelength as 3.8m and count that wave is traveling at a frequency of 2 Hz. What would the velocity of the wave be?
  - $v = f \lambda$
  - f = 2 Hz
  - λ = 3.8 m
  - Then v = (3.8)x(2) => 7.6 m/s

Waves



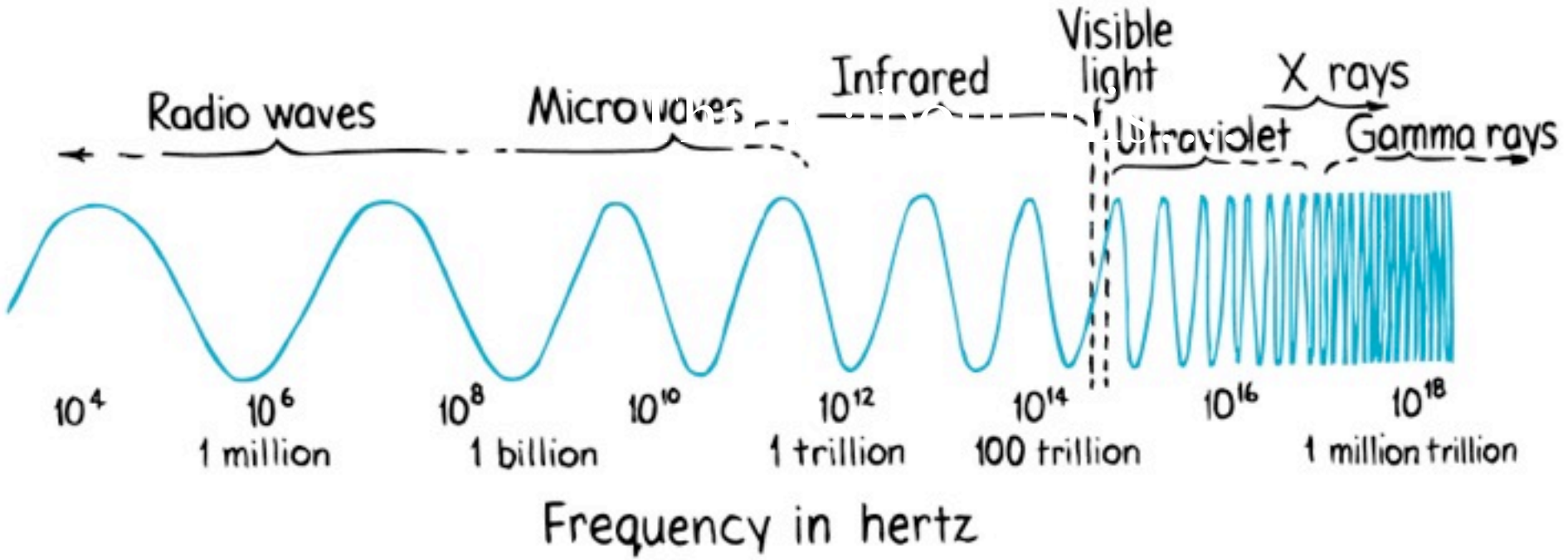
Waves

VI. Electromagnetic waves: waves that require no medium to travel



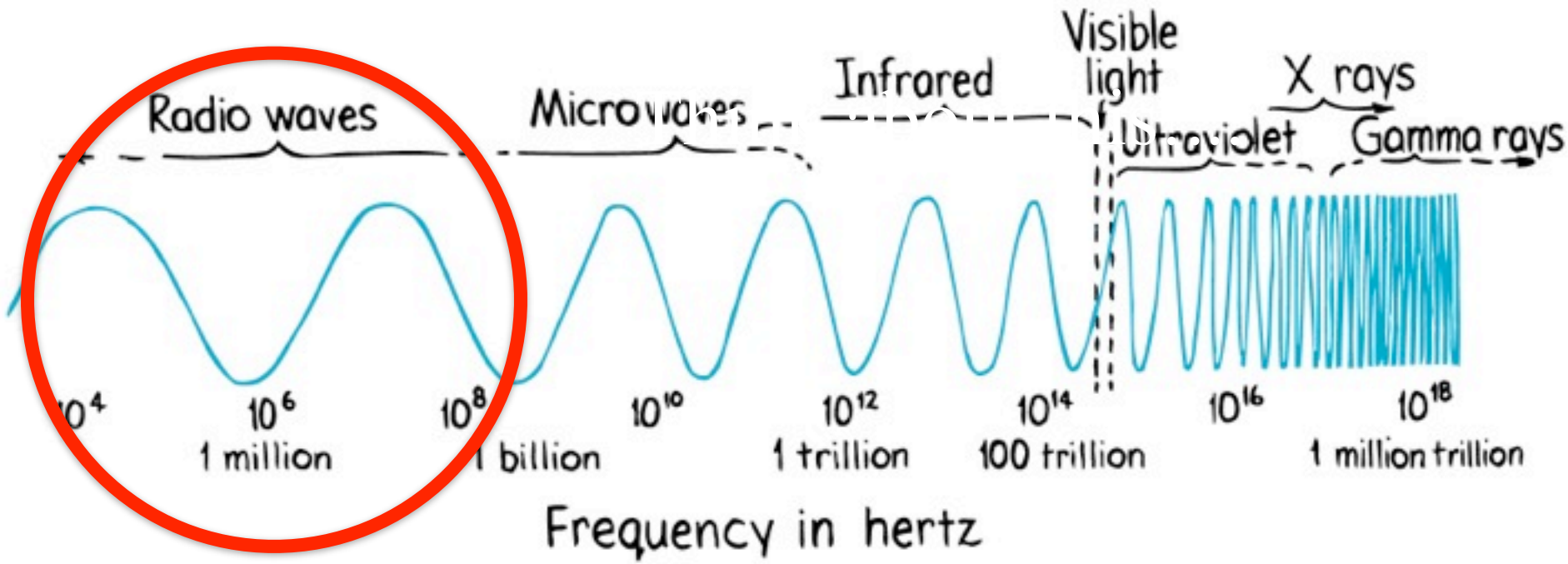
Waves

VI. Electromagnetic waves: waves that require no medium to travel



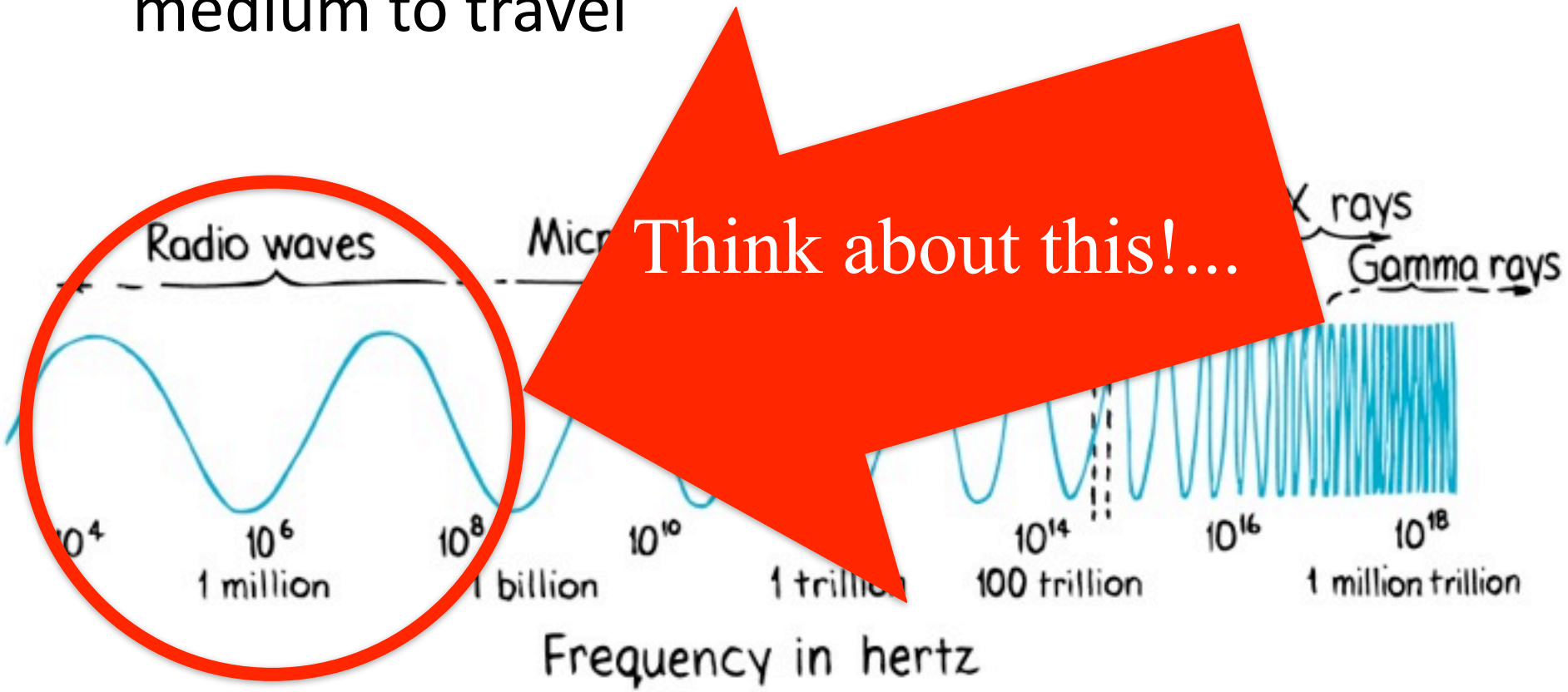
Waves

VI. Electromagnetic waves: waves that require no medium to travel



Waves

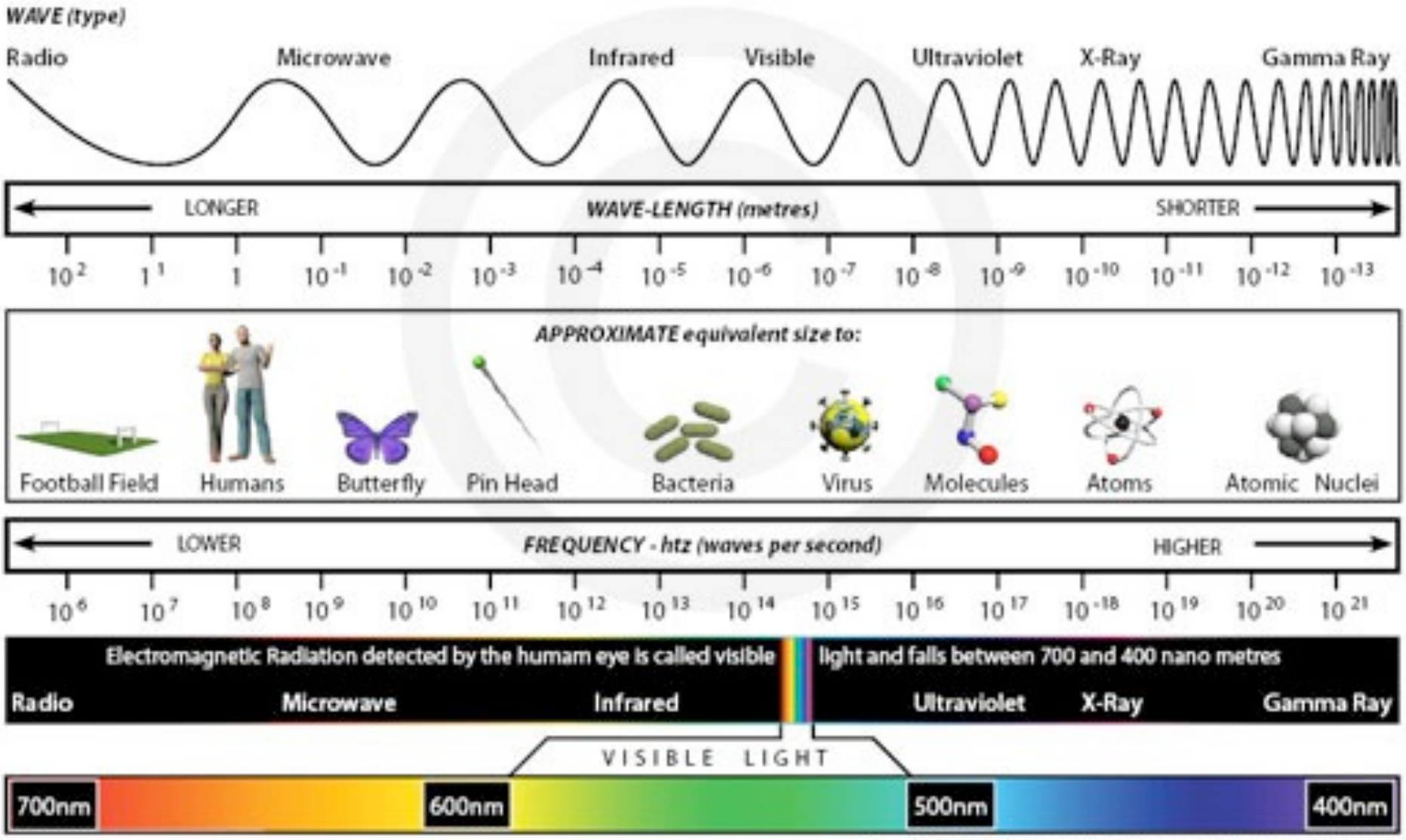
VI. Electromagnetic waves: waves that require no medium to travel

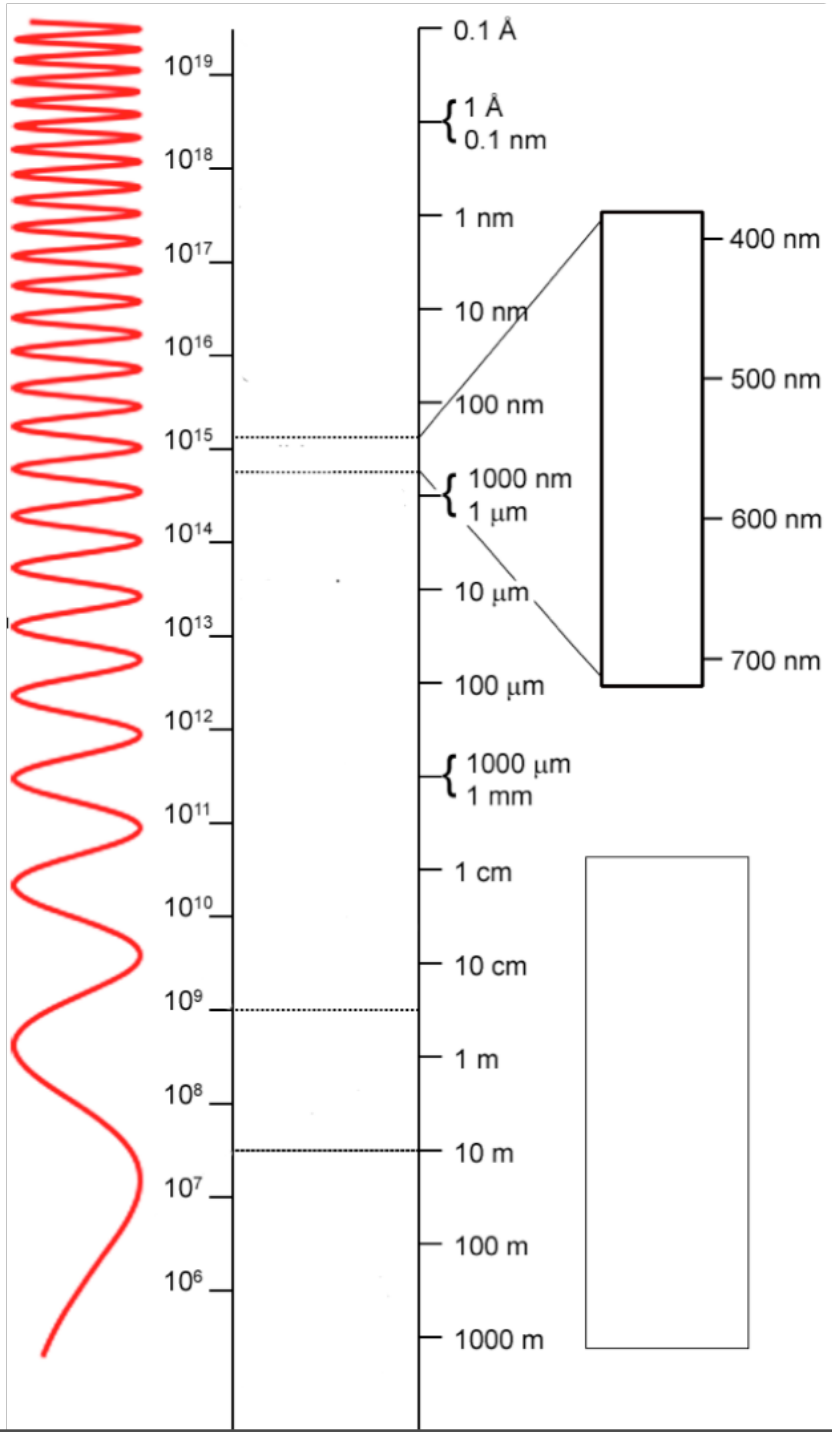


THE ELECTRO MAGNETIC SPECTRUM

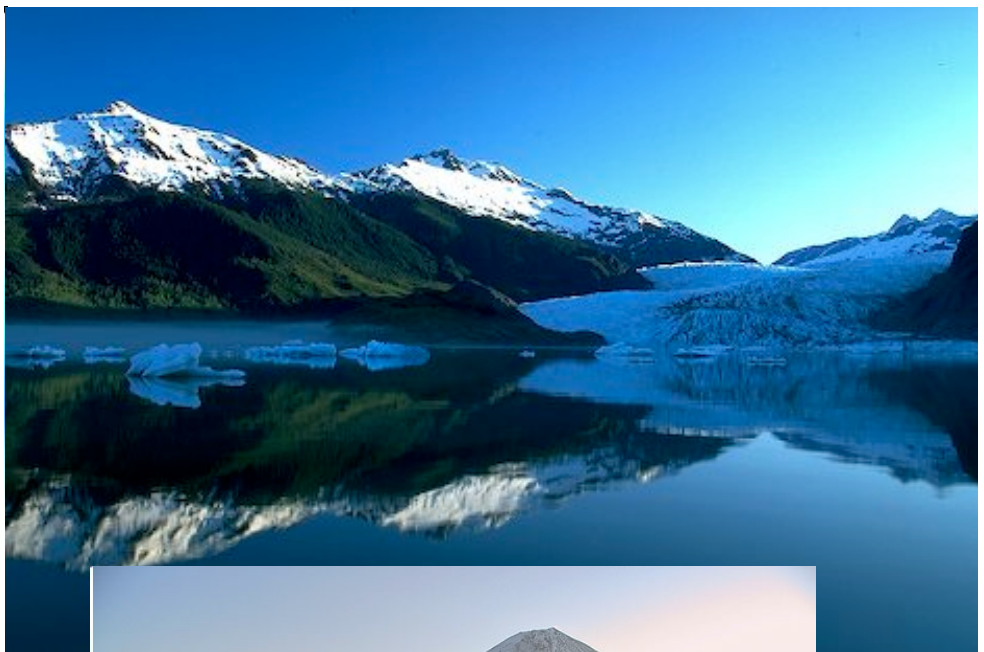
1 metre = 100cm 1 cm = 10mm 1 millimetre = 1000 microns 1 micron = 1000 nanometres (nm) - one nanometer is one billionth of a metre

$10^{-5} = 0.00001$ $10^{5} = 100{,}000$

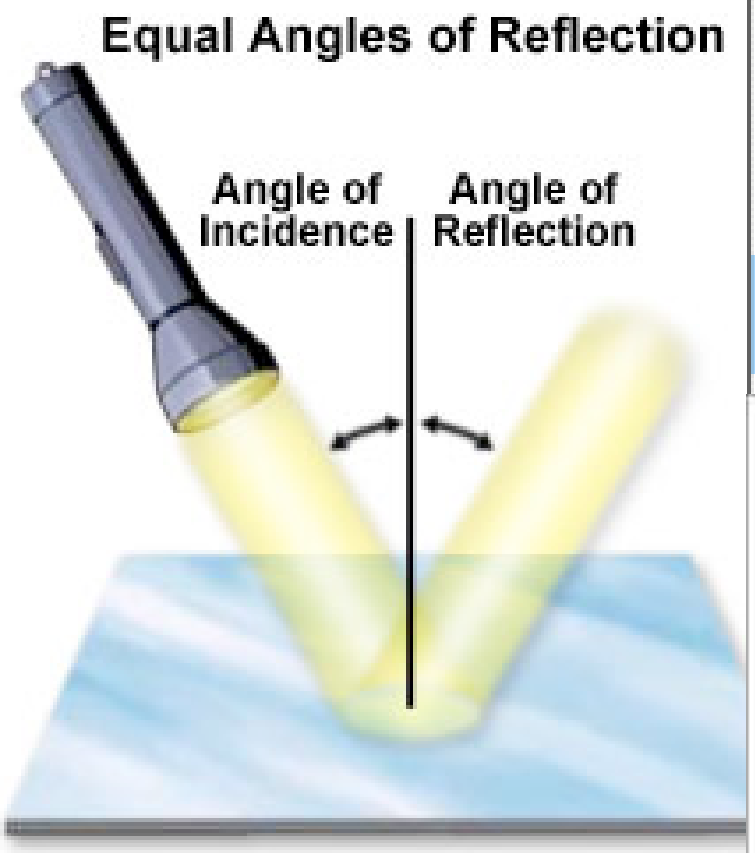


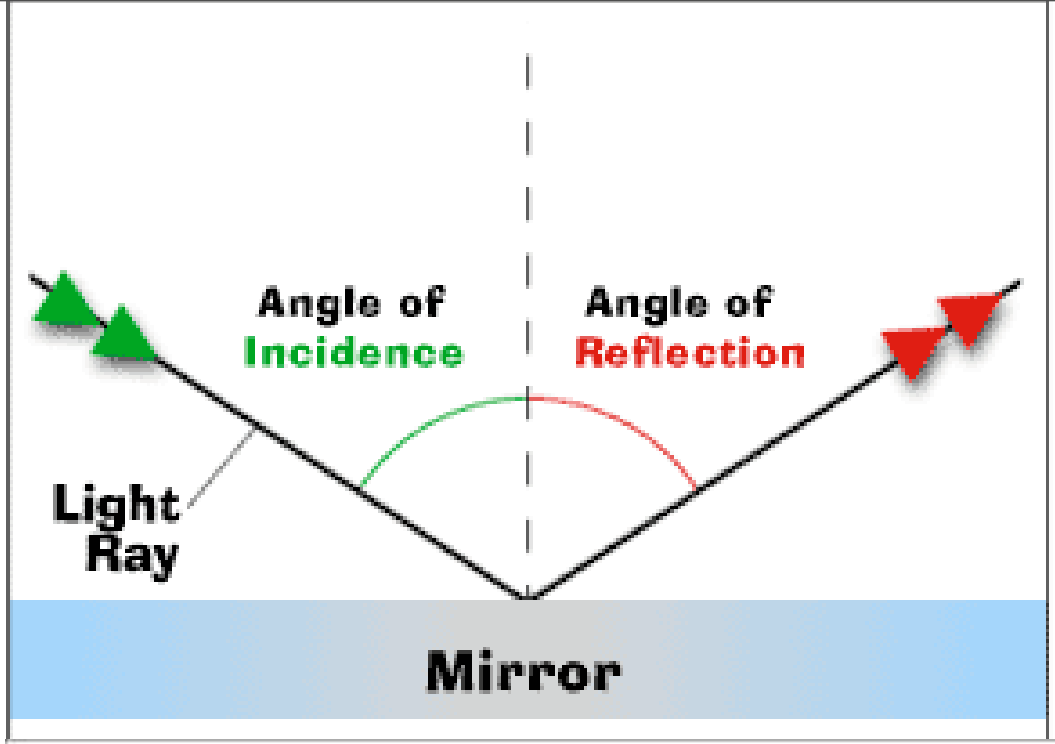

10^{19}
10^{18}
10^{17}
10^{16}
10^{15}
10^{14}
10^{13}
10^{12}
10^{11}
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
0.1 Å
1 Å
0.1 nm
1 nm
10 nm
100 nm
1000 nm
1 μm
10 μm
100 μm
1000 μm
1 mm
1 cm
10 cm
1 m
10 m
100 m
1000 m
400 nm
500 nm
600 nm
700 nm

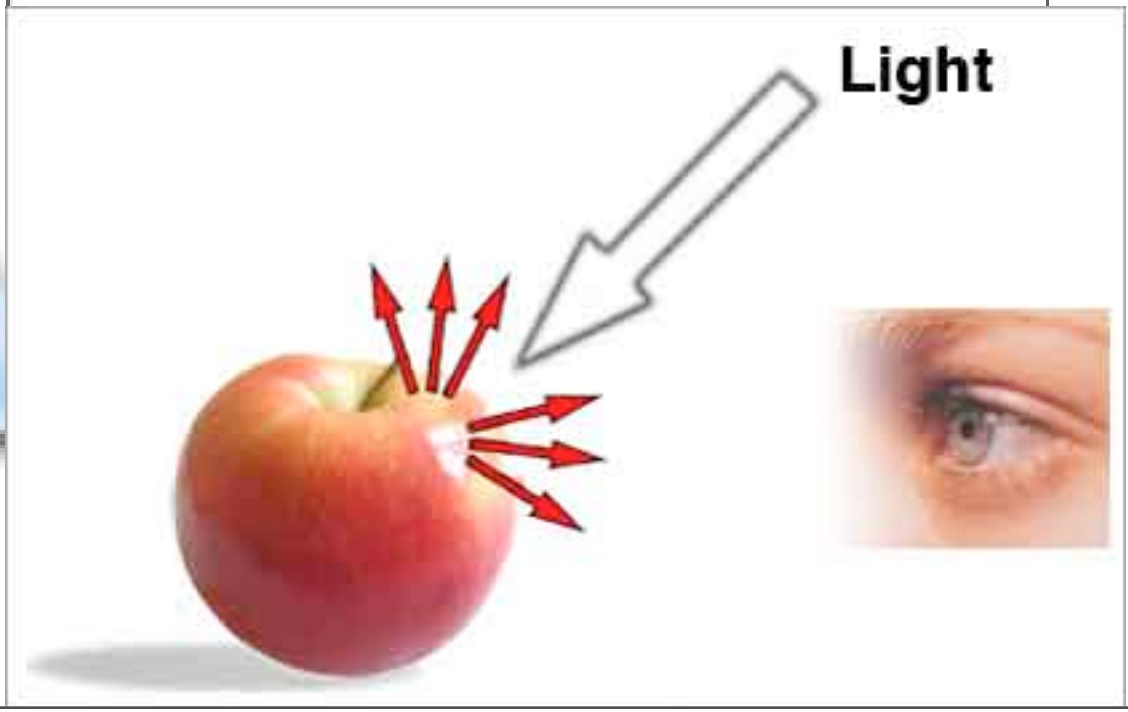
Waves
Reflection



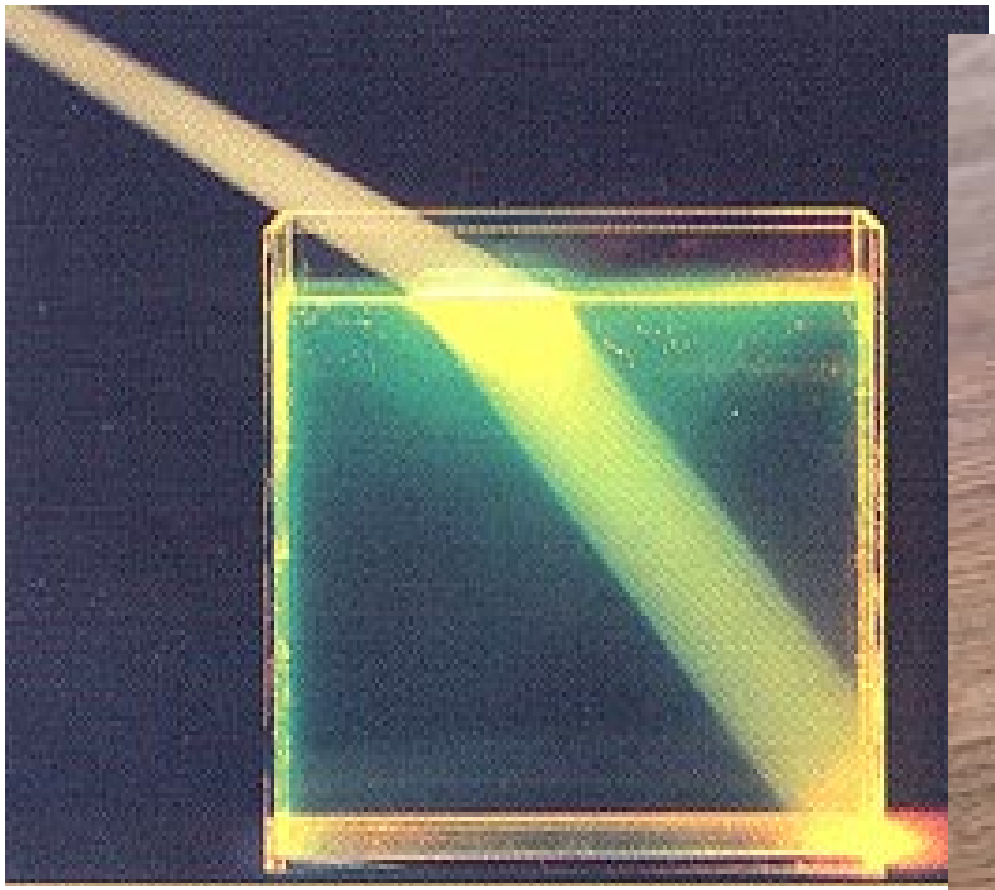
Waves


Equal Angles of Reflection
Angle of Incidence
Angle of Reflection


Angle of Incidence
Angle of Reflection
Light Ray
Mirror

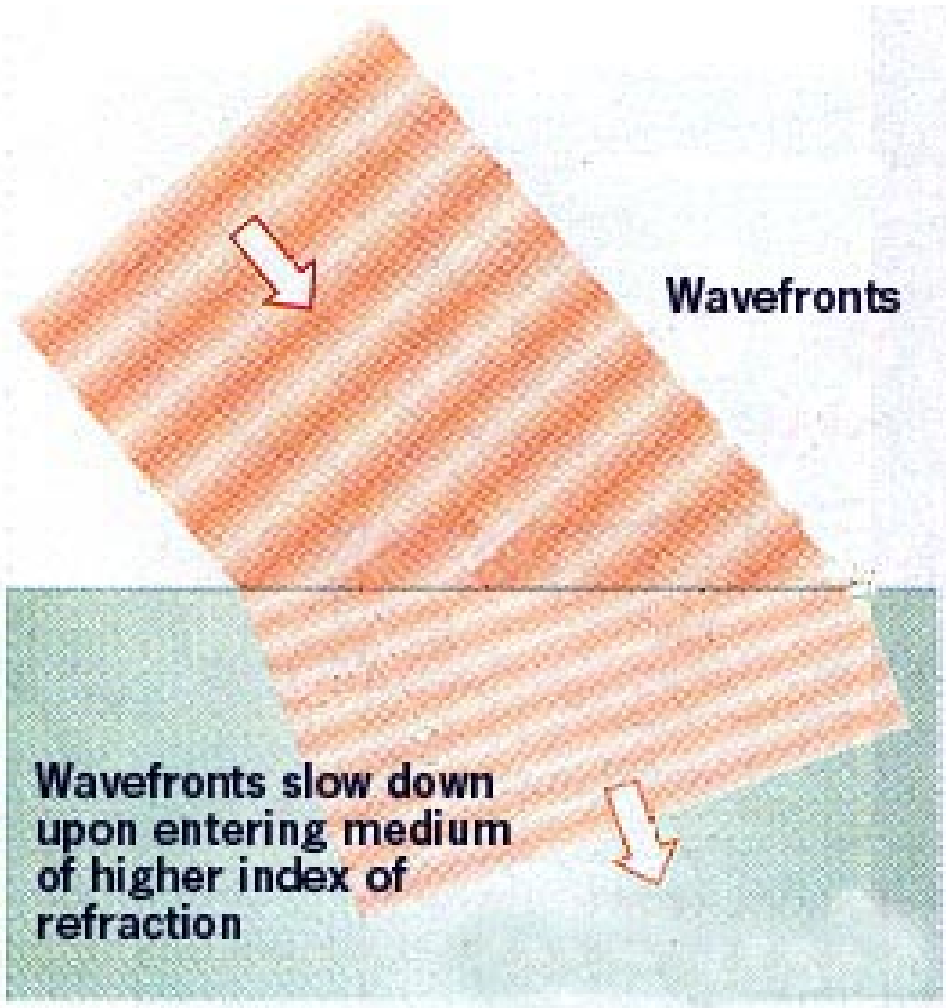

Light

Waves
Refraction

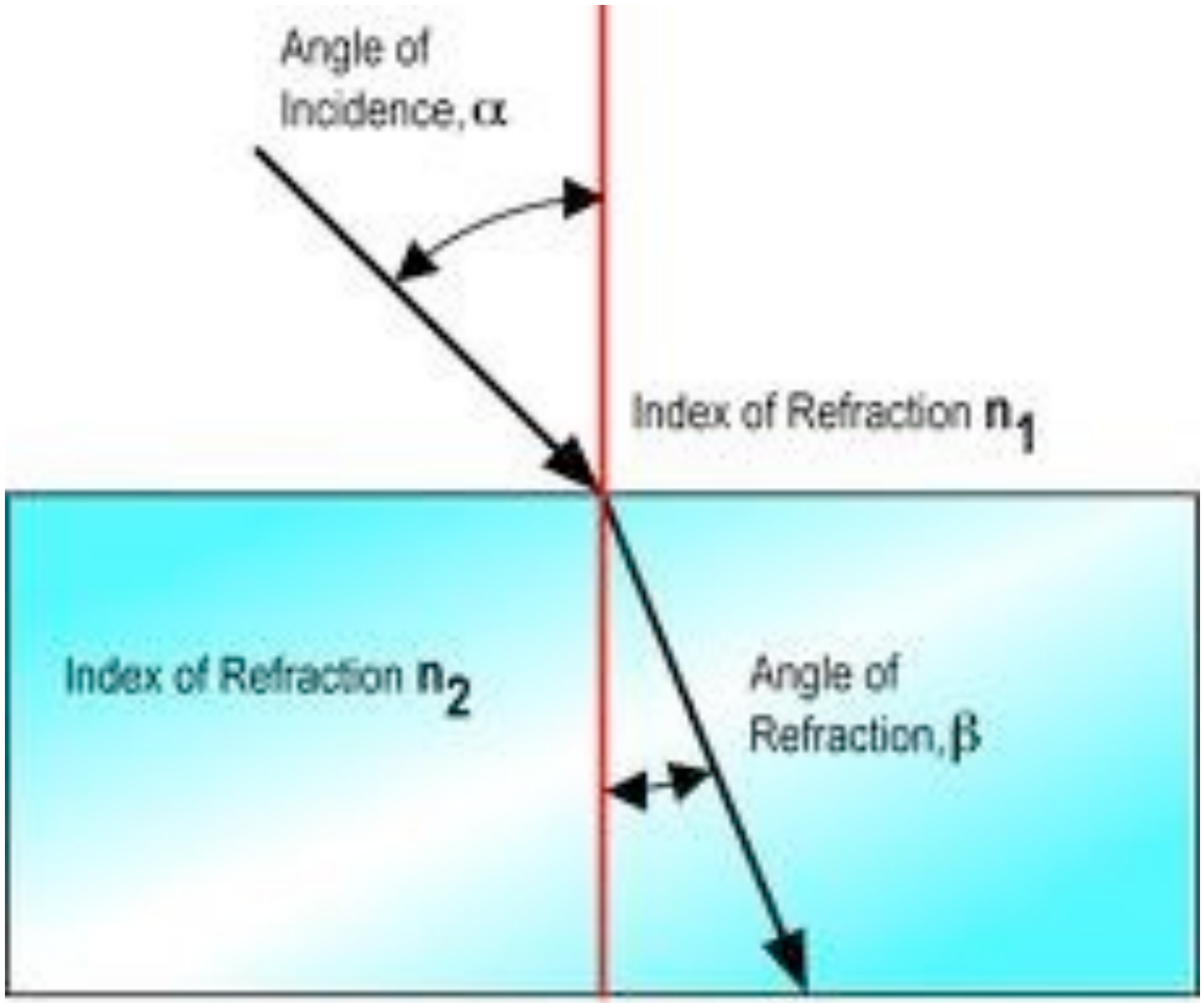


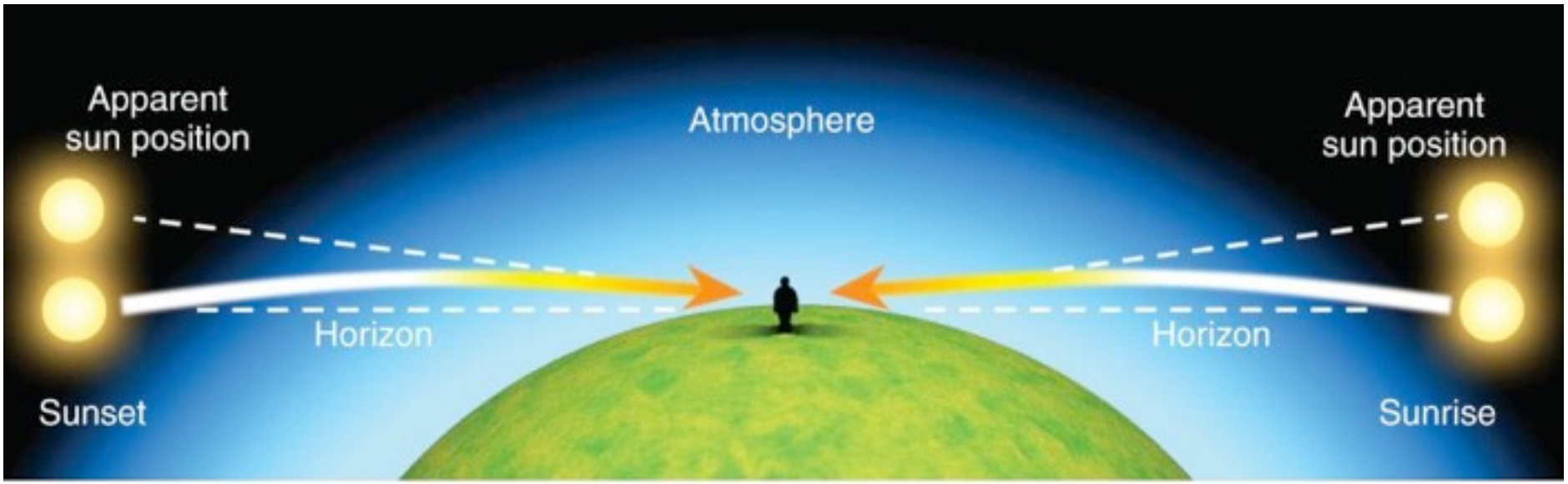
Waves

- Refraction: a change in direction and speed of a wave due to the medium
  - bends towards normal in more dense object
  - bends away from normal in less dense object

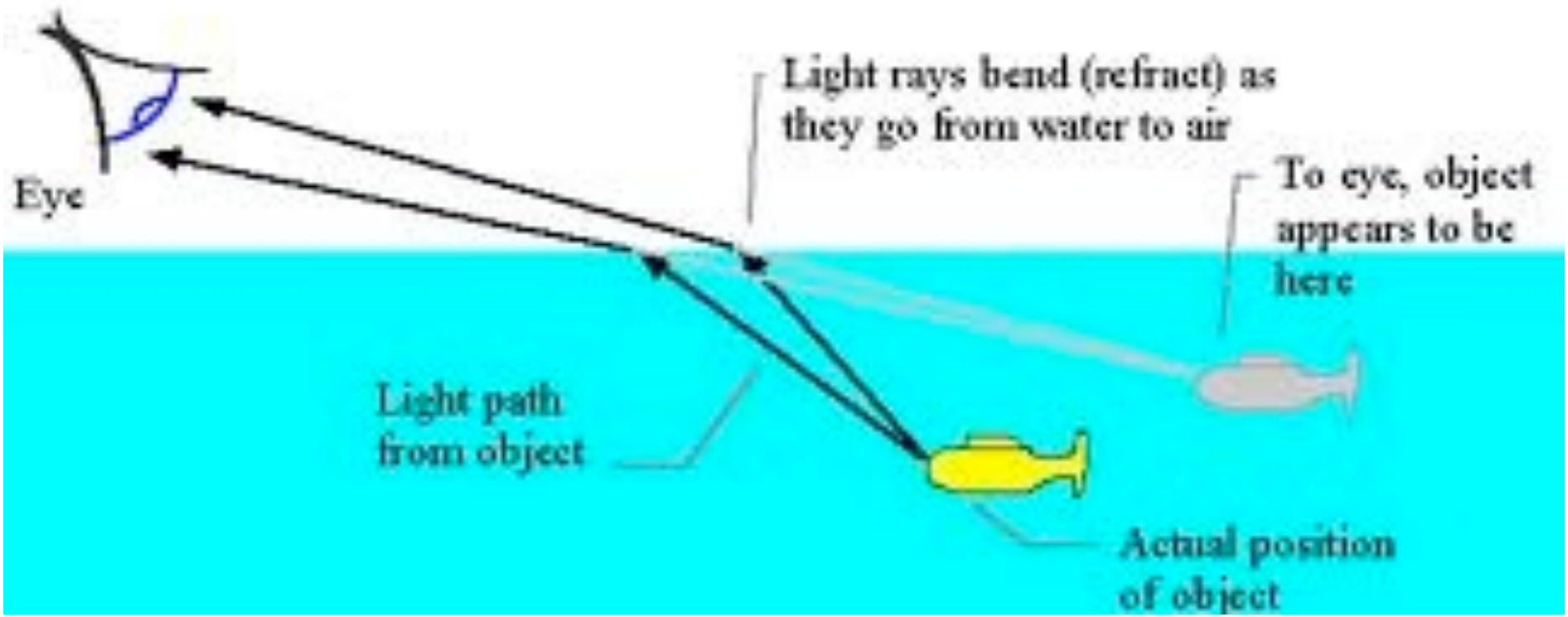


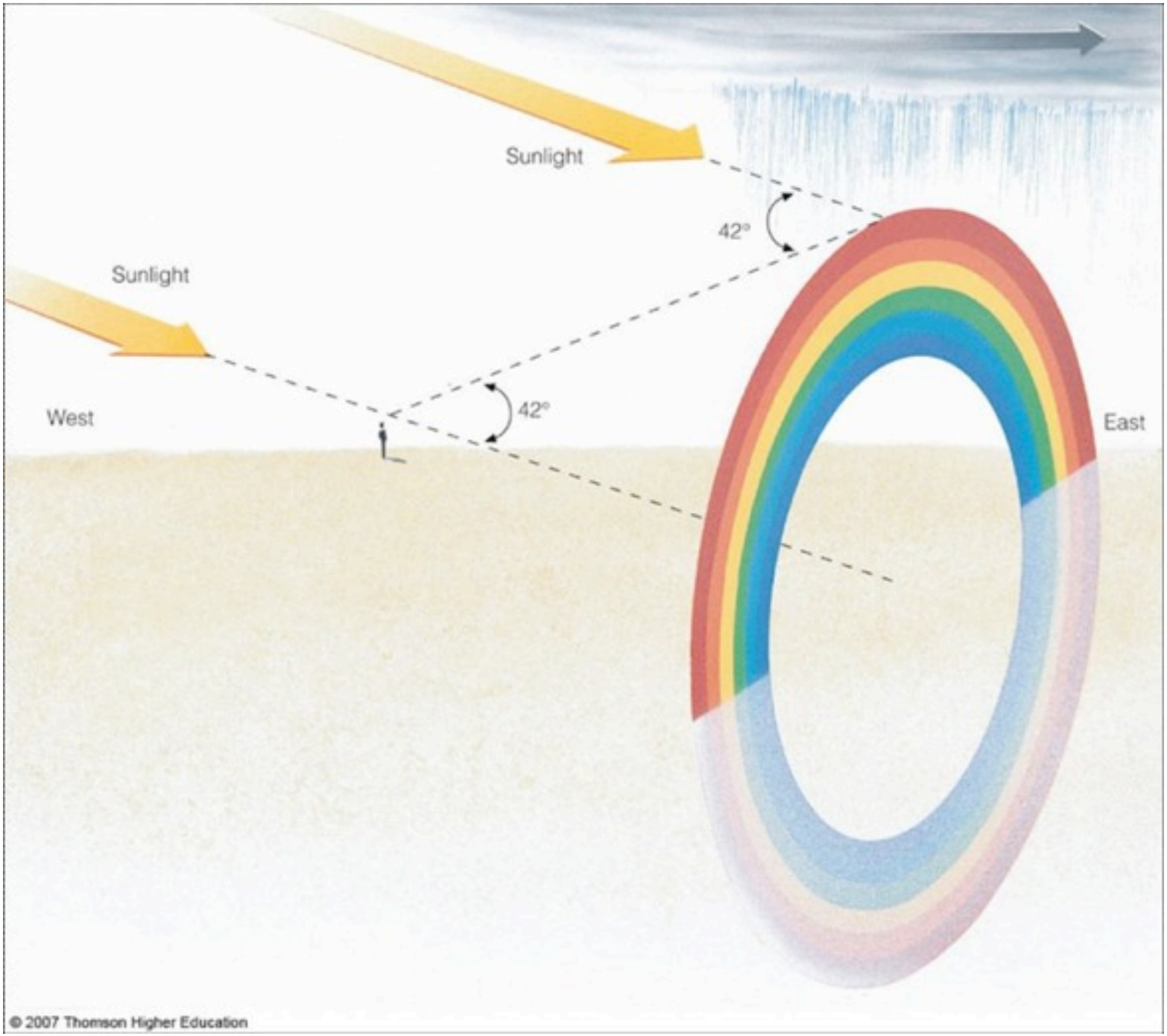
Waves


Angle of
Incidence, α
Index of Refraction n_1
Index of Refraction n_2
Angle of
Refraction, β

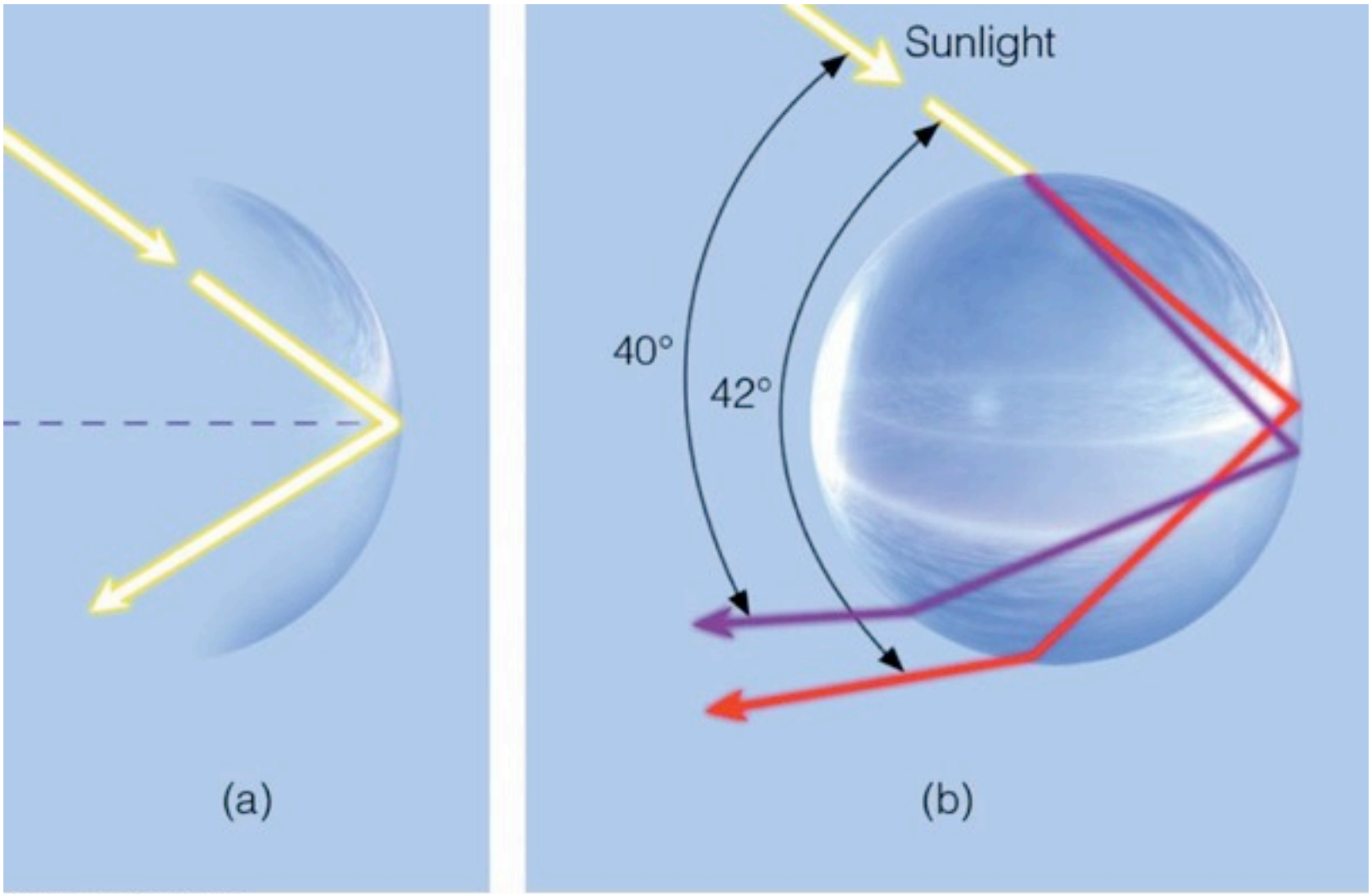


Refraction at Surface of Water

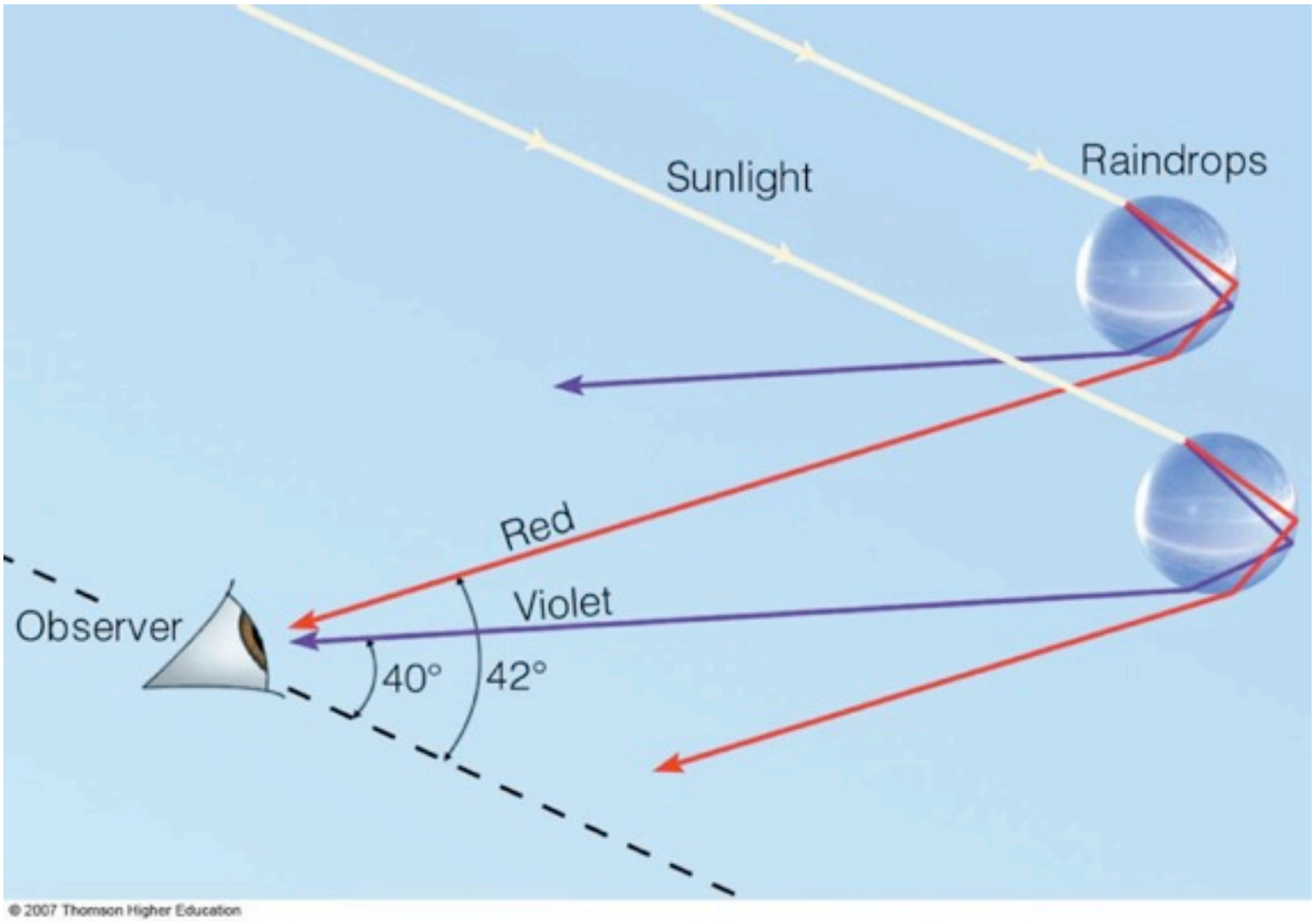



Sunlight
42°
Sunlight
West
42°
East
© 2007 Thomson Higher Education

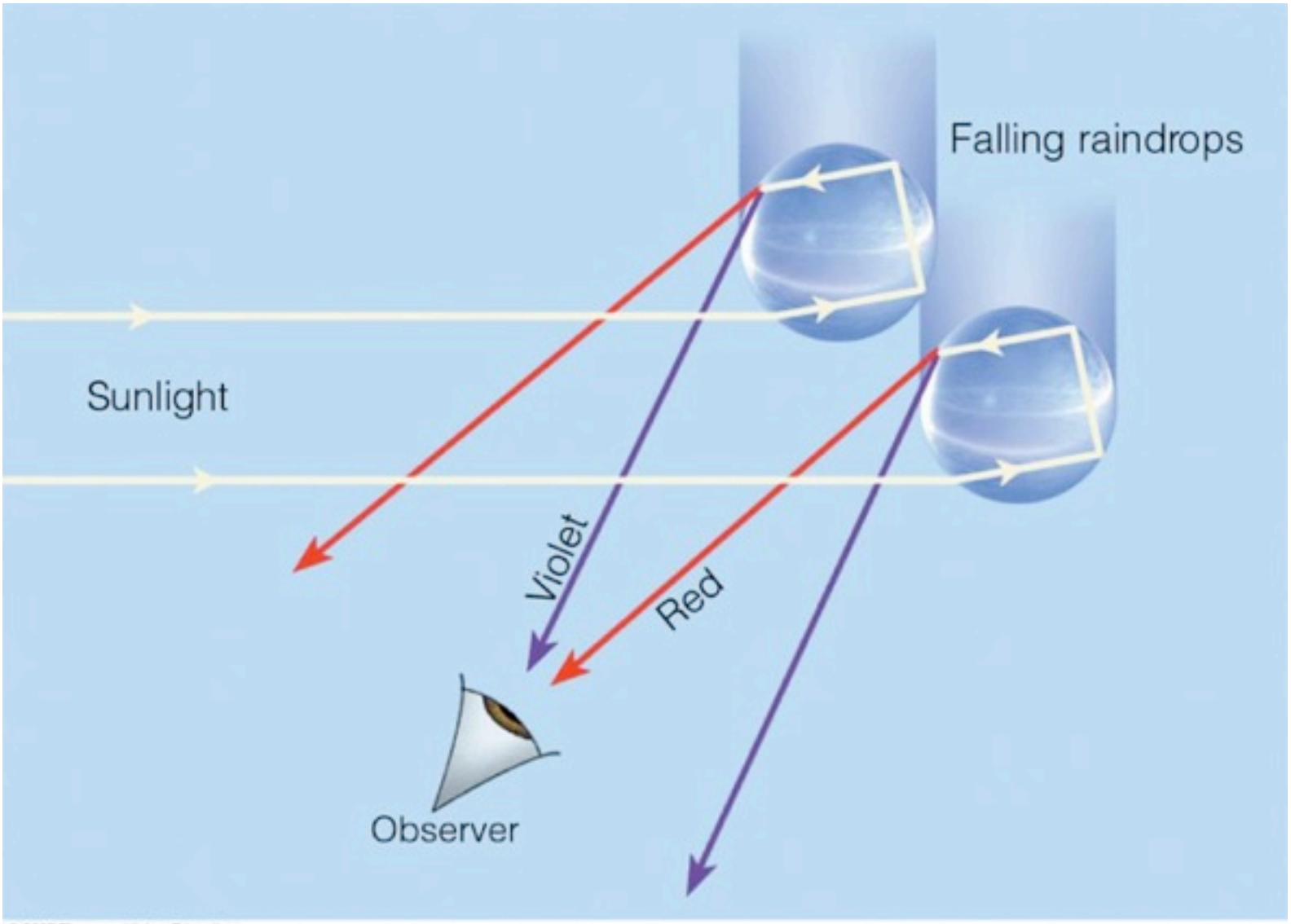
Waves



Waves


Sunlight
Raindrops
Red
Violet
Observer
40°
42°
© 2007 Thomson Higher Education

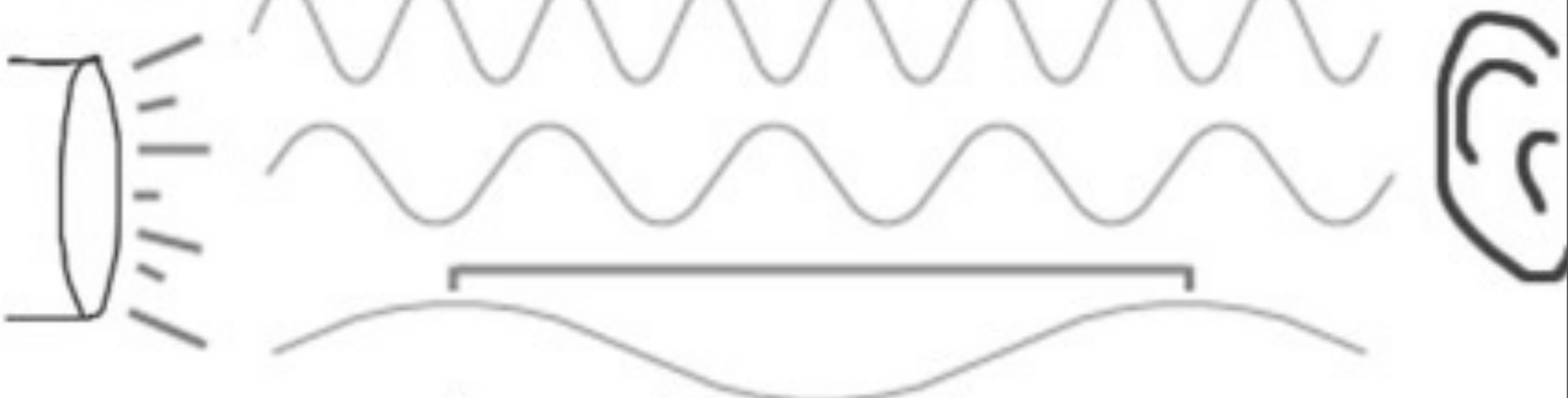
Waves



WHY CAN WE HEAR?

The waves are travelling about the same speed,
this is the number of waves needed in a
hundredth of a second to reach the ear

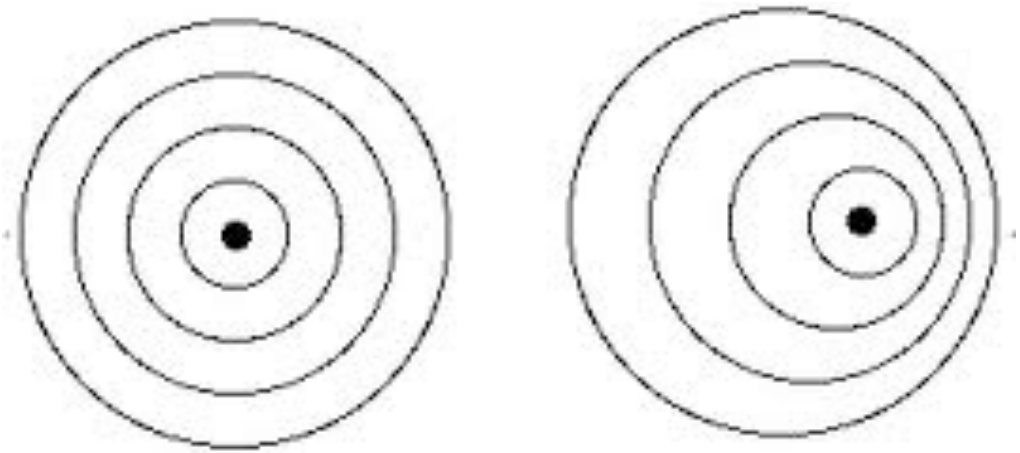
Short wavelength means more waves
High frequency, high sound



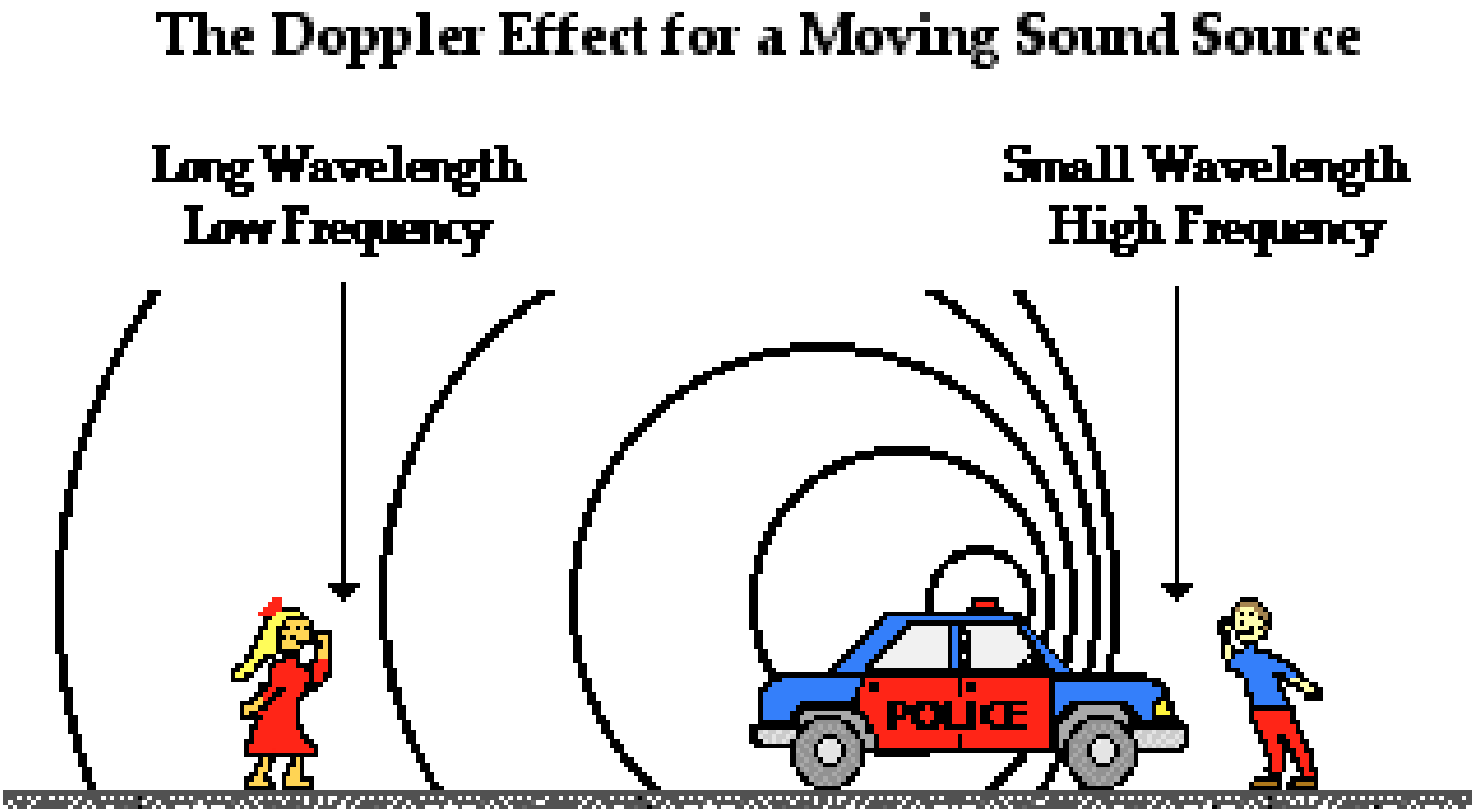
Long wavelength means less waves
low frequency and low sound

Waves

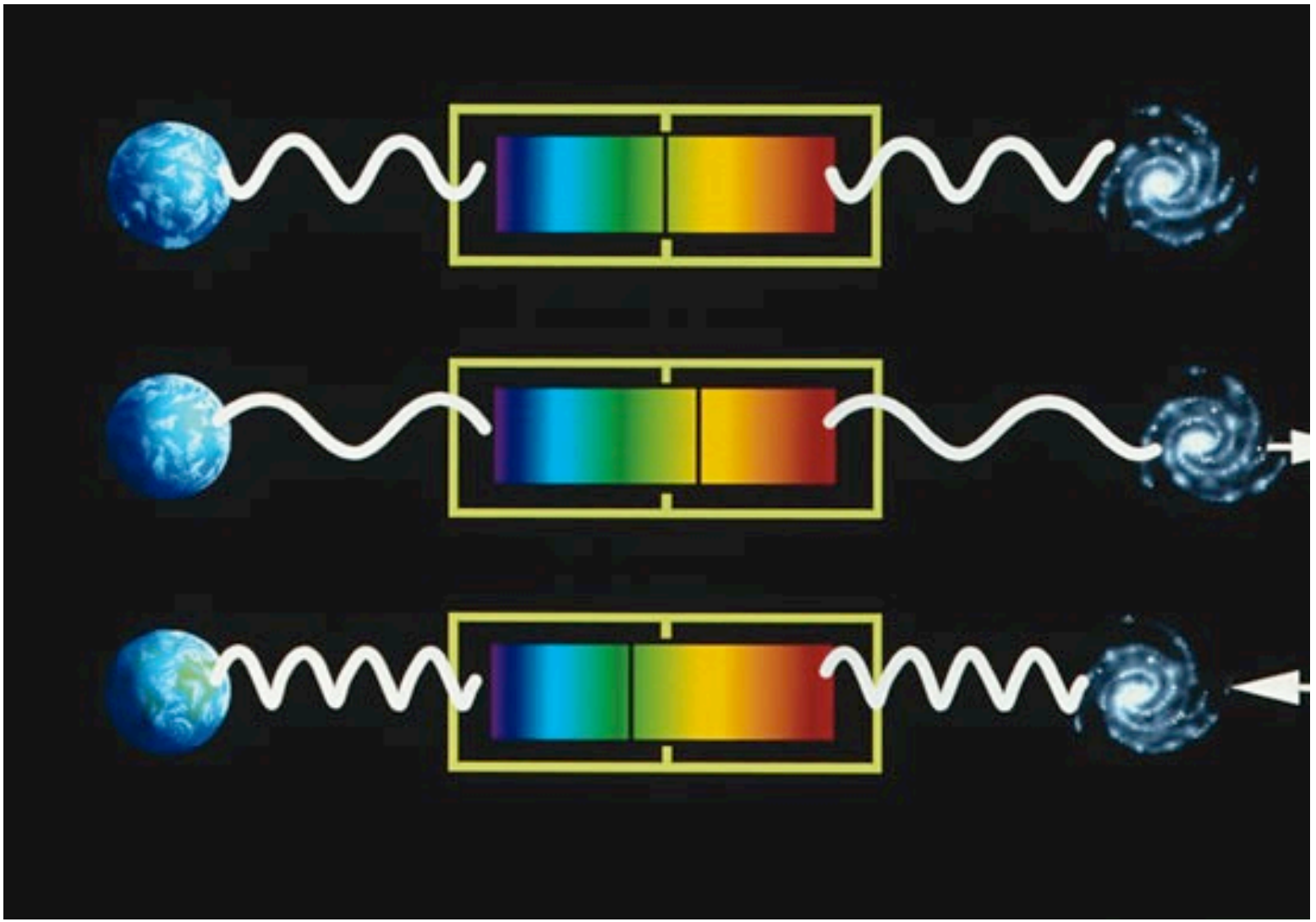
- _____ Effect: produced when a wave source is _____ in one direction.
  - When it moves away the wavelength gets _____ (lower _____)
  - When it moves towards the wavelength gets _____ (higher _____)



Waves

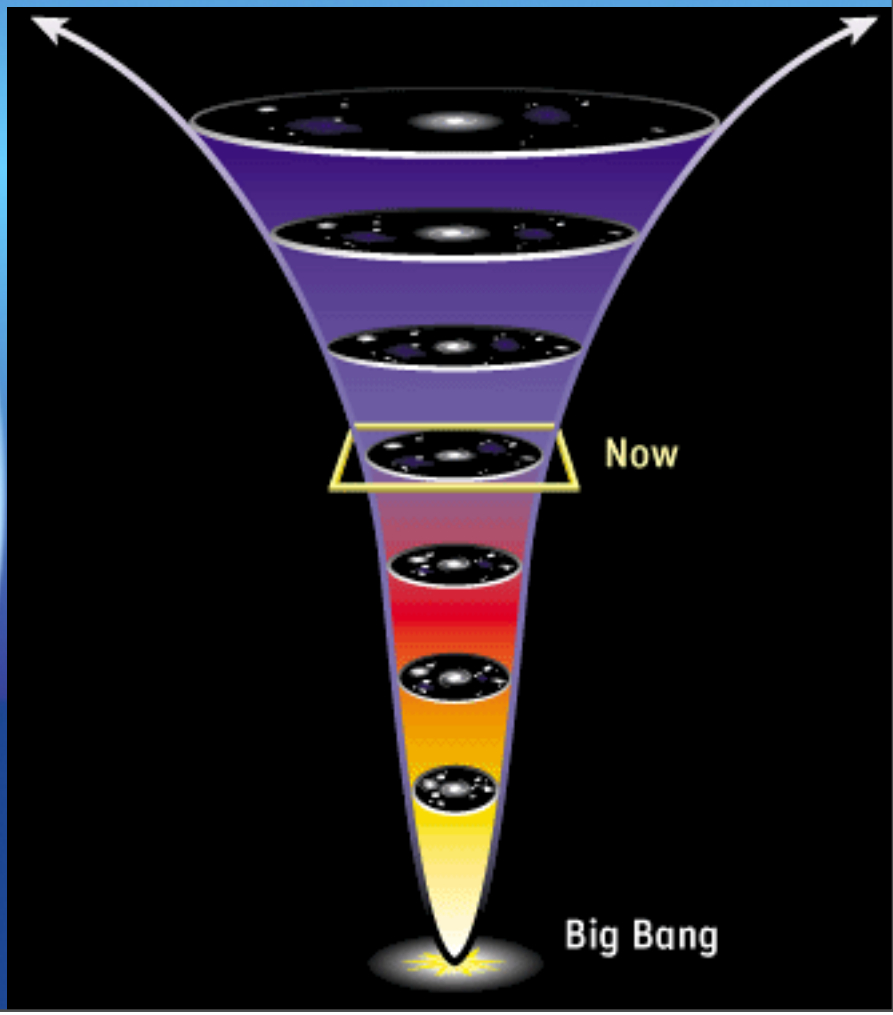

The Doppler Effect for a Moving Sound Source
Long Wavelength
Low Frequency
Small Wavelength
High Frequency
POLICE

Waves



A. <u>Big Bang Theory</u>: Universe started with a big bang, or **explosion**, and has been expanding ever since.

1. rapid **expansion** of space itself.
2. **13.7** billion years, based off oldest light in universe.



Waves

- Support of the Big bang
  - _____ shift of galaxies seen
    - Means galaxies are moving away - increased wavelength
  - Background radiation
    - Radiation comes from everything (will talk about more when we discuss nuclear chemistry)
  - Abundance of Hydrogen
    - Big bang to hot even for Fusion so Hydrogen is left over